Lloyd's Register

Rules and Regulations for the Classification of Ships, July 2009

Notice No. 5

Effective Date of Latest Amendments:

See page 1

Issue date: February 2010

RULES AND REGULATIONS FOR THE CLASSIFICATION OF SHIPS, *July 2009*

Notice No. 5

This Notice contains amendments within the following Sections of the *Rules and Regulations for the Classification of Ships, July 2009.* The amendments are effective on the dates shown:

Part	***Chapter***	***Section***	***Effective date***
1		Classification	1 July 2010
1	3	2, 3, 9, 11, 14	1 July 2010
1	3	6	Corrigendum
3	13	7, 8, 9	1 July 2010
5	1	5	1 July 2010
5	2	15	1 July 2010
5	4	9	1 July 2010
5	5	1, 3, 5	1 July 2010
5	8	2	1 July 2010
5	9	2, 8	1 July 2010
5	10	1, 15	1 July 2010
5	12	1, 2, 3, 4, 5	1 July 2010
5	12	10, 11	Corrigenda
5	13	1, 3, 4, 6, 7, 8, 12, 13, 14	1 July 2010
5	14	5, 6, 10	1 July 2010
5	15	1, 2, 3	1 July 2010
5	21	1, 2, 3, 4, 5, 6, 7	1 July 2010
5	22	2	1 July 2010
5	23	Whole Chapter	1 July 2010
6	1	1, 2, 3, 7	1 July 2010
6	2	1, 3, 5, 6, 7, 9, 10, 11, 13, 14, 16, 17	1 July 2010
7	5	5	1 July 2010
7	6	5	1 July 2010
7	9	2, 3, 4, 5	1 July 2010
7	13	Whole Chapter	1 July 2010
7	14	Whole Chapter	1 July 2010
7	15	Whole Chapter	1 July 2010
7	16	Whole Chapter	1 July 2010
7	17	Whole Chapter	1 July 2010
8	2	11	1 July 2010

It will be noted that the amendments also include corrigenda, which are effective from the date of this Notice.

The *Rules and Regulations for the Classification of Ships, July 2009* are to be read in conjunction with this Notice No. 5. The status of the Rules is now:

Rules for Ships	Effective date:	July 2009
Notice No. 1	Effective dates:	1 January 2010 & Corrigenda
Notice No. 2	Effective dates:	1 January 2010 & Corrigenda
Notice No. 3	Effective dates:	1 January 2010 & Corrigendum
Notice No. 4	Effective dates:	1 January 2010 & Corrigenda
Notice No. 5	Effective dates:	1 July 2010 & Corrigenda

Preface to Part 1

Effective date 1 July 2010

CLASSIFICATION

The following explanatory note is offered to assist those concerned in the application of these Rules and Regulations.

Explanatory Note

Ship classification may be regarded as the development and worldwide implementation of published Rules and Regulations which, in conjunction with proper care and conduct on the part of the Owner and operator, will provide for:

1. the structural strength of (and where necessary the watertight integrity of) all essential parts of the hull and its appendages;

2. the safety and reliability of the propulsion and steering systems; and

3. the effectiveness of those other features and auxiliary systems which have been built into the ship in order to establish and maintain basic conditions on board whereby appropriate cargoes and personnel can be safely carried whilst the ship is at sea, at anchor, or moored in harbour.

Lloyd's Register (LR) maintains these provisions by way of the periodical visits by its Surveyors to the ship as defined in the Regulations in order to ascertain that the vessel currently complies with those Rules and Regulations. Should significant defects become apparent or damages be sustained between the relevant visits by the Surveyors, the Owner and operator are required to inform LR without delay. Similarly any modification which would affect Class must receive prior approval by LR.

A ship is said to be in Class when the Rules and Regulations which pertain to it have, in the opinion of LR, been complied with, or when special dispensation from compliance has been granted by LR.

It should be appreciated that, in general, classification Rules and Regulations do not cover such matters as the ship's floatational stability, life-saving appliances~~, pollution prevention arrangements~~, and structural fire protection, detection and extinction arrangements where these are covered by the *International Convention for the Safety of Life at Sea, 1974, its Protocol of 1978*, and the amendments thereto~~, nor~~ . Nor do they cover pollution prevention arrangements where these are covered by the *International Convention for the Prevention of Pollution from Ships, 1973*, its protocol of 1978, and the amendments thereto. Nor do they protect personnel on board from dangers connected with their own actions or movement around the ship. This is because the handling of these aspects is the prerogative of the National Authority with which the ship is registered. A great many of these authorities, however, delegate such responsibilities to the Classification Societies who then undertake them in accordance with agreed procedures.

Part 1, Chapter 3
Periodical Survey Regulations

Effective date 1 July 2010

■ *Section 2*
Annual Surveys – Hull and machinery requirements

2.2 Annual Surveys

2.2.20 For ~~ships fitted with automation equipment for~~ main propulsion, essential auxiliary and emergency machinery control engineering systems, a general examination of the equipment and arrangements is to be carried out. ~~Records of changes to the hardware and software used for control and monitoring systems for propelling and essential auxiliary machinery since the original issue (and their identification) are to be reviewed by the attending Surveyor.~~ Records of modifications are to be made available for review by the attending Surveyor. The documentation required by Pt 6, Ch 1, including configuration management, are to be reviewed following system modifications to confirm compliance with applicable Rules. Satisfactory operation of the safety devices and control systems is to be verified. For ships having **UMS** or **CCS** notation, a general examination of the control engineering equipment required for these notations is also to be carried out.

■ *Section 3*
Intermediate Surveys – Hull and machinery requirements

3.2 Intermediate Surveys

3.2.10 In addition to the foregoing, in the case of all **oil tankers** (including ore/oil and ore/bulk/oil ships) the following are to be dealt with where applicable:

(a) An examination of cargo, crude oil washing, bunker, ballast, steam and vent piping on the weather decks, as well as vent masts and headers. If upon examination there is any doubt as to the condition of the piping, the piping may be required to be pressure tested, gauged, or both.

(b) A ~~General Examination~~ general examination within the ~~areas~~ zones and spaces deemed as ~~dangerous~~ hazardous, such as cargo pump rooms and spaces adjacent to and zones above cargo tanks, for defective and non-certified safe-type electrical equipment, improperly installed, defective and dead-end wiring. An electrical insulation resistance test of the circuits terminating in, or passing through, the ~~dangerous areas~~ hazardous zones and spaces is to be carried out. If the ship is not in a gas free condition the results of previously recorded test readings may be accepted.

3.2.12 For **chemical tankers**, in addition to the applicable requirements of 3.2.1 to 3.2.9 the following are to be dealt with where applicable:

(a) Examination of vent line drainage arrangements.

(b) Verification that the cargo heating/cooling system is in good condition.

(c) Verification that the ship's cargo hoses are approved and in good condition.

(d) Verification that, where applicable, pipelines and independent cargo tanks are electrically bonded to the hull.

(e) An examination of cargo, cargo washing, bunker, ballast, steam and vent piping on the weather decks, as well as vent masts and headers. If upon examination there is any doubt as to the condition of the piping, the piping may require to be pressure tested, gauged or both.

(f) A General Examination within the ~~areas~~ zones and spaces deemed as ~~dangerous~~ hazardous, such as cargo pump rooms and spaces adjacent to and zones above cargo tanks, for defective and non-certified safe-type electrical equipment, improperly installed, defective and dead-end wiring. An electrical insulation resistance test of the circuits terminating in, or passing through, the ~~dangerous areas~~ hazardous zones and spaces is to be carried out. If the ship is not in a gas free condition the results of previously recorded test readings may be accepted.

CORRIGENDUM

■ *Section 6*
Special Survey – Bulk carriers – Hull requirements

6.6 Close-up Survey

(*Part only shown*)

Table 3.6.1 Close-up Survey – Single skin bulk carriers

Special Survey IV (Ships 20 years old and over)
(2) All transverse webs with associated plating and longitudinals in each water ballast tank ~~(i.e. topside, hopper side or side tank)~~.
(3) All transverse bulkheads in ballast tanks, including stiffening system.
(4) ~~All transverse webs with associated plating and longitudinals in each water ballast tank.~~ All cargo hold transverse bulkheads, including internal structure of upper and lower stools, where fitted.

Effective date 1 July 2010

■ *Section 9*
Ships for liquefied gases

9.2 Annual Surveys – Basic requirements

9.2.11 Mechanical ventilation fans in gas ~~dangerous~~ hazardous zones and spaces ~~and zones~~ are to be visually examined. Adequate spare parts should be carried for each type of fan installed.

9.2.12 Electrical equipment, cables and supports in gas ~~dangerous zones~~ hazardous zones and spaces shall be examined as far as practicable. Alarms and safety systems associated with pressurised lighting systems and any safety device associated with non-safe type electrical equipment that is protected by air-locks are to be verified.

9.6 Intermediate Surveys

9.6.2 In addition to the requirements for Annual Survey and the requirements of 3.2.1 to 3.2.8, the following are to be dealt with as applicable:

(a) Examination of means for draining the vent piping system.

(b) Verification that pipelines and cargo tanks are electrically bonded to the hull.

(c) Verification that the heating arrangements, if any, for steel structures are satisfactory.

(d) Where required by the manufacturer's maintenance instructions, cargo tank and inter-barrier space pressure and vacuum relief valve settings are to be checked and adjusted as required. Cargo tank pressure relief valve harbour settings are also to be checked, if applicable. Cargo tank pressure relief valves are to lift at a pressure not more than the percentage given below, above the maximum vapour pressure for which the tanks have been approved.
   - For 0 to 1,5 bar (0 to 1,5 kgf/cm^2), 10 per cent.
   - For 1,5 to 3,0 bar (1,5 to 3,0 kgf/cm^2), 6 per cent.
   - For pressures exceeding 3,0 bar (3,0 kgf/cm^2), 3 per cent.
   - Valves may be removed from the tanks for the purpose of checking.

(e) A General Examination within the ~~areas~~ zones and spaces deemed as ~~dangerous~~ hazardous, such as cargo compressor rooms and spaces adjacent to and zones above cargo areas, for defective and non-certified safe-type electrical equipment, improperly installed, defective and dead wiring. An electrical insulation resistance test of the circuits terminating in, or passing through the ~~dangerous areas~~ hazardous zones and spaces, is to be carried out. If the ship is not in a gas free condition the results of previously recorded test readings may be accepted.

■ *Section 11*
Machinery surveys – General requirements

11.2 Complete Surveys

11.2.7 Water ingress detection arrangements fitted on single hold cargo ships having length less than 80 m and bulk carriers and flooding detection systems fitted on passenger ships are to be tested to demonstrate that they are in good working order. Alternatively, this testing may be conducted during the required hull Special Survey space examinations, *see also* 5.3.

Existing paragraphs 11.2.7 *to* 11.2.10 *have been renumbered* 11.2.8 *to* 11.2.11.

■ *Section 14*
Electrical equipment

14.3 Docking Surveys

14.3.1 For tankers five years old and over, 14.2.11 is to be complied with. In addition, an electrical insulation resistance test of the circuits terminating in, or passing through, the ~~dangerous areas~~ hazardous zones and spaces is to be carried out.

Part 3, Chapter 13
Ship Control Systems

Effective date 1 July 2010

■ *Section 7*
Equipment

Existing sub-Sections 7.7 *to* 7.12 *have been deleted from* Section 7 *and are now shown in new* Section 8.

~~**7.7 Windlass design and testing**~~

~~**7.8 Winch design and testing**~~

~~**7.9 Testing of equipment**~~

~~**7.10 Structural requirements associated with anchoring**~~

~~**7.11 Structural requirements for windlasses on exposed fore decks**~~

~~**7.12 Structural requirements associated with towing and mooring**~~

■ *Section 8*
Windlass design and testing

~~7.7~~ 8.1 Windlass design ~~and testing~~

~~*7.7.1*~~ *8.1.1* A windlass of sufficient power and suitable for the size of chain is to be fitted to the ship. Where Owners require equipment significantly in excess of Rule requirements, it is their responsibility to specify increased windlass power.

~~*7.7.2*~~ *8.1.2* The following performance criteria are to be used as a design basis for the windlass:

(a) The windlass is to have sufficient power to exert a continuous duty pull over a period of 30 minutes of:

- for specified design anchorage depths up to 82,5 m:

Chain cable grade	Duty pull, P, in N (kgf)
U1	~~$36{,}79d_c^2$ ($3{,}75d_c^2$)~~ $37{,}5d_c^2$ ($3{,}82d_c^2$)
U2	~~$41{,}68d_c^2$ ($4{,}25d_c^2$)~~ $42{,}5d_c^2$ ($4{,}33d_c^2$)
U3	~~$46{,}60d_c^2$ ($4{,}75d_c^2$)~~ $47{,}5d_c^2$ ($4{,}84d_c^2$)

- for specified design anchorage depths greater than 82,5 m:
  $P_1 = P + (D_a - 82{,}5)$ ~~0,214~~ 0,27 d_c^2 N
  [$P_1 = P + (D_a - 82{,}5)$ ~~0,0218~~ 0,0275 d_c^2 kgf]

where
d_c is the chain diameter, in mm
D_a is the specified design anchorage depth, in metres
P is the duty pull for anchorage depth up to 82,5 m
P_1 is the duty pull for anchorage depths greater than 82,5 m.

(b) The windlass is to have sufficient power to exert, over a period of at least two minutes, a pull equal to the greater of:
  (i) short term pull:
  1,5 times the continuous duty pull as defined in ~~7.7.2(a)~~ 8.1.2(a), or
  (ii) anchor breakout pull:

$$12{,}18W_a + \frac{7{,}0L_c\, d_c^2}{100} \text{ N}$$

$$\left(1{,}24W_a + \frac{7{,}1L_c\, d_c^2}{1000} \text{ kgf}\right)$$

  where:
  L_c is the total length of chain cable on board, in metres, as given by Table 13.7.2
  W_a is the mass, in kilograms, of bower anchor as given in Table 13.7.2.

(c) The windlass, with its braking system in action and in conditions simulating those likely to occur in service, is to be able to withstand, without permanent deformation or brake slip, a load, applied to the cable, given by:
  $K_b d_c^2\ (44 - 0{,}08d_c)$ N
  $(K_b d_c^2\ (44 - 0{,}08d_c)$ kgf)
  where K_b is given in Table ~~13.7.6~~ 13.8.1.

The performance criteria are to be verified by means of shop tests in the case of windlasses manufactured on an individual basis. Windlasses manufactured under LR's *Type Approval Scheme for Marine Engineering Equipment* will not require shop testing on an individual basis.

Table ~~13.7.6~~ 13.8.1 Values of K_b

8.1.3 Calculations for torque transmitting components are to be based on 1500 hours of operation with a nominal load spectrum factor of $K_m = 1{,}0$. Alternatively unlimited hours with $K_m = 0{,}8$ can be applied.

8.1.4 Where the available input torque exceeds the torque required for anchor breakout then torque overload protection is to be fitted.

8.1.5 An arrangement to release the anchor and chain in the event of windlass power failure is to be provided.

Existing paragraph 7.7.6 *has been renumbered* 8.1.6.

8.2 Calculations

~~*7.7.3*~~ *8.2.1* Where shop testing is not possible and Type Approval has not been obtained, calculations demonstrating compliance with ~~7.7.2~~ 8.1.2 are to be submitted together with detailed plans and an arrangement plan showing the following components:

- Shafting;
- Gearing;
- Brakes;
- Clutches.

8.2.2 The maximum stress from load cases stated in Table 13.8.2 are not to exceed the limits stated in Table 13.8.3.

Table 13.8.2 Design load cases for windlass and chainstopper

Load case	Condition	Note
1	Continuous pull	*See* 8.1.2(a)
2	Over load pull	*See* 8.1.2(b)
3	Brake holding load	*See* 8.1.2(c)

Table 13.8.3 Permissible stress for design load cases

Stress	Load case	
	1 and 2	3
	Permissible stress	
Tension	0,8*Y*	0,9*Y*
Compression or bending	0,8*Y*	0,9*Y*
Shear	0,7*Y*	0,7*Y*
Combined	0,85*Y*	0,9*Y*

NOTES

1. Where a component is subjected to axial tensile, axial compressive, bending or shear stress, F_c is to be calculated in the normal manner.
2. Where a component is subjected to a combination of co-existent stresses, F_c is the combined stress which is to be calculated as follows:

   Combined bending and tension

   $F_c = 1{,}25f_c + f_{bt}$

   Combined bending and compression

   $F_c = f_c + f_{bc}$

   Combined bending, tension and shear

   $$F_c = \sqrt{(1{,}25f_t + f_{bt})^2 + 3f_q^2}$$

   Combined bending, compression and shear

   $$F_c = \sqrt{(f_c + f_{bc})^2 + 3f_q^2}$$

where

f_t is the calculated axial tensile stress
f_c is the calculated axial compressive stress
f_{bt} is the calculated maximum tensile stress due to bending about both principal axes
f_{bc} is the calculated maximum compressive stress due to bending about both principal axes
f_q is the calculated shear stress
Y is the specified 0,2 per cent proof stress for the material

8.2.3 The following criteria are to be used for gearing design:

(a) Torque is to be based on the performance criteria specified in 8.1.2.
(b) The use of an equivalent torque, T_{eq}, for dynamic strength calculations is acceptable but the derivation is to be submitted to LR for consideration.
(c) The application factor for dynamic strength calculation, K_A, is to be 1,15.
(d) Calculations are to be based on 1500 hours of operation.
(e) The static torque is to be 1,5 x T_n where T_n is the nominal torque.
(f) The minimum factors of safety for load capacity of spur and helical gears, as derived using ISO 6336 or a relevant National or International standard acceptable to LR, are to be 1,5 for bending stress and 0,6 for contact stress.

8.2.4 Keyways are to be designed to a relevant National or International standard acceptable to LR.

8.2.5 The maximum stress in brake components is not to exceed the permissible stress stated in Table 13.8.3.

8.3 Control arrangements

8.3.1 All control devices are to be capable of being controlled from readily accessible positions and protected against unintentional operation.

8.3.2 The maximum travel of the levers is not to exceed 600 mm if movable in one direction only, or 300 mm to either side from a central position if movable in both directions. They are to move toward the right when hauling and toward the left when paying out. Alternatively, they are to move backward when hauling and forward when paying out.

8.3.3 Wherever practical, the lever is to move in the direction of the intended movement.

8.3.4 For lever-operated brakes, the brake is to engage when the lever is pulled and disengage when the lever is pushed. The physical effort on the brake for the operator is not to exceed 160 N.

8.3.5 For pedal-operated brakes the maximum travel is not to exceed 250 mm and the physical effort for the operator is not to exceed 320 N.

8.3.6 The handwheel or crankhandle is to actuate the brake when turned clockwise and release it when turned counterclockwise. The physical effort for the operator is not to exceed 250 N for speed regulation and 500 N at any moment.

8.3.7 When not provided with automatic sequential control, separate push-buttons are to be provided for each direction of operation.

8.3.8 The push-buttons are to actuate the machinery when depressed and stop and effectively brake the machinery when released.

8.3.9 The above mentioned individual push-buttons may be replaced by two ‘start’ and ‘stop’ push-buttons.

8.4 Maintenance arrangements

8.4.1 Access is to be provided for inspection of reduction gears, bearings, brakes, etc.

8.4.2 Accessible manual lubrication points, including nipples, are to be provided for both for oil and grease, as applicable.

8.4.3 Gear-boxes are to be provided with adequate access arrangements for monitoring and replacing oil.

8.5 Protection arrangements

8.5.1 Where applicable, moving parts of windlass machinery are to be provided with suitable railings and/or guards to prevent injury to personnel.

8.5.2 Protection is to be provided for preventing persons from coming into contact with surfaces having temperatures over 50°C.

8.5.3 Steel surfaces not protected by lubricant are to be protected by a coating in accordance with the requirements of a relevant National or International Standard acceptable to LR.

8.6 Marking and identification

8.6.1 Controls are to be permanently marked for identification, unless their functions are readily apparent. If required, instructions are to be permanently marked and readily visible.

8.7 Testing and acceptance

Existing paragraph 7.7.4 *has been renumbered* 8.7.1.

Existing paragraph 7.7.5 *has been renumbered* 8.7.2.

~~7.8~~ 8.8 Winch design and testing

Existing paragraph 7.8.1 *has been renumbered* 8.8.1.

Existing paragraph 7.8.2 *has been renumbered* 8.8.2.

~~7.9~~ 8.9 Testing of equipment

Existing paragraphs 7.9.1 *to* 7.9.4 *have been renumbered* 8.9.1 *to* 8.9.4.

~~7.10~~ 8.10 Structural requirements associated with anchoring

Existing paragraphs 7.10.1 *to* 7.10.11 *have been renumbered* 8.10.1 *to* 8.10.11.

~~7.11~~ 8.11 Structural requirements for windlasses on exposed fore decks

Existing paragraph 7.11.1 *has been renumbered* 8.11.1.

Existing paragraph 7.11.2 *has been renumbered* 8.11.2.

Existing paragraph 7.11.3 *has been renumbered* 8.11.3.

Existing paragraphs 7.11.4 *to* 7.11.7 *have been renumbered* 8.11.4 *to* 8.11.7.

8.11.8 Bolts are to be of ISO 898/1 material Grade 8.8, 10.9 or 12.9 or equivalent and are to be pretensioned by controlled means to 70 to 90 per cent of their yield stress. Pretensioning is to be in accordance with the manufacturer's instructions and, in general, pretensioning by bolt torqueing up to bolt size M30 may be used. Beyond this, pretensioning is to be carried out by an hydraulic tensioning device and the elongation of the bolts measured to determine pre-load. Where resin chocks are proposed plans and calculations are to be submitted for consideration.

Existing paragraph 7.11.8 *has been renumbered* 8.11.9.

Table ~~13.7.7~~ 13.8.4
Allowable stress in windlass supporting structure

Existing paragraph 7.11.9 *has been renumbered* 8.11.10.

~~7.12~~ 8.12 Structural requirements associated with towing and mooring

Existing paragraphs 7.12.1 *to* 7.12.3 *have been renumbered* 8.12.1 *to* 8.12.3.

Existing paragraph 7.12.4 *has been renumbered* 8.12.4.

Existing paragraph 7.12.5 *has been renumbered* 8.12.5.

Table ~~13.7.8~~ 13.8.5
Minimum design load for deck fittings and supporting structure

Fig. ~~13.7.3~~ 13.8.3 Design load applied to fittings

Existing paragraph 7.12.6 *has been renumbered* 8.12.6.

Existing paragraph 7.12.7 *has been renumbered* 8.12.7.

Existing paragraph 7.12.8 *has been renumbered* 8.12.8.

Table ~~13.7.9~~ 13.8.6
Allowable stress within the supporting structure of shipboard fittings

Existing paragraphs 7.12.9 *and* 7.12.10 *have been renumbered* 8.12.9 *and* 8.12.10.

Existing paragraph 7.12.11 *has been renumbered* 8.12.11.

Existing paragraphs 7.12.12 *to* 7.12.14 *have been renumbered* 8.12.12 *to* 8.12.14.

■ *Section ~~8~~ 9* Mooring of ships at single point moorings

~~8.1~~ 9.1 General

Existing paragraph 8.1.1 *has been renumbered* 9.1.1.

Existing paragraph 8.1.2 *has been renumbered* 9.1.2.

~~8.2~~ 9.2 Arrangements

Existing paragraph 8.2.1 *has been renumbered* 9.2.1.

Existing paragraph 8.2.2 *has been renumbered* 9.2.2.

Fig. ~~13.8.1~~ 13.9.1
Positioning of fairleads, chainstoppers and pedestal roller leads

Table ~~13.8.1~~ 13.9.1
Deadweight group for shipboard fittings requirements

Existing paragraph 8.2.3 *has been renumbered* 9.2.3.

Table ~~13.8.2~~ 13.9.2
Fittings requirements for deadweight group

Existing paragraph 8.2.4 *has been renumbered* 9.2.4.

Fig. ~~13.8.2~~ 13.9.2 Special shackle

Existing paragraph 8.2.5 *has been renumbered* 9.2.5.

Existing paragraph 8.2.6 *has been renumbered* 9.2.6.

Existing paragraphs 8.2.7 *and* 8.2.8 *have been renumbered* 9.2.7 *and* 9.2.8.

■ *Section ~~9~~ 10*
Emergency towing arrangements

~~9.1~~ 10.1 Structural requirements

Existing paragraphs 9.1.1 *and* 9.1.2 *have been renumbered* 10.1.1 *and* 10.1.2.

Existing paragraph 9.1.3 *has been renumbered* 10.1.3.

Table ~~13.9.1~~ 13.10.1
Permissible stress values

Existing paragraph 9.1.4 *has been renumbered* 10.1.4.

~~9.2~~ 10.2 Chafing chain and wire or fibre rope for Emergency Towing Arrangements

Existing paragraph 9.2.1 *has been renumbered* 10.2.1.

Existing paragraph 9.2.2 *has been renumbered* 10.2.2.

Fig. ~~13.9.1~~ 13.10.1
Typical outboard chafing chain end

Existing paragraph 9.2.3 *has been renumbered* 10.2.3.

Table ~~13.9.2~~ 13.10.2
Nominal diameter of common link for chafing chains for ETA

Existing paragraphs 9.2.4 *and* 9.2.5 *have been renumbered* 10.2.4 *and* 10.2.5.

Part 5, Chapter 1
General Requirements for the Design and Construction of Machinery

Effective date 1 July 2010

■ *Section 5*
Trials

5.2 Sea trials

5.2.5 The following information is to be available on board for the use of the master and designated personnel:

- The results of trials to determine stopping times, ship headings and distance;
- For ships having multiple propellers, the results of trials to determine the ability to navigate and manoeuvre with one or more propellers inoperative.
- For ships having a single propulsor driven by multiple engines or electric motors, the results of trials to determine the ability to navigate and manoeuvre with the largest engine or electric motor inoperative.

Part 5, Chapter 2
Oil Engines

Effective date 1 July 2010

■ *Section 15*
Electronically controlled engines

15.1 Scope

15.1.1 The requirements of this Section are applicable to engines for propulsion, auxiliary or emergency power purposes with ~~software-based electronic control of~~ programmable electronic systems implemented and used to control fuel injection timing and duration, and which may also control combustion air or exhaust systems. ~~Other systems with software-based electronic control, such as~~ The requirements of this Section also apply to programmable electronic systems used to control other functions (e.g. starting ~~air,~~ and control air ~~and~~, cylinder ~~oil~~ lubrication ~~systems~~ etc.) ~~when~~ where essential ~~to~~ for the operation of the engine~~, are to be included and all applicable requirements of this Section are to be applied~~.

15.1.5 During the life of the engine details of any proposed changes to hardware, software, control and monitoring systems which may affect the safety and reliable operation of the engine are to be submitted ~~and approved by~~ to LR for approval.

15.2 Plans and particulars

(*Part only shown*)

15.2.1 In addition to the plans and particulars required by Section 1 the following information is to be submitted:

(d) A schedule of testing and trials to demonstrate that the engine is capable of operating as described in the design statement, and any testing required to verify the conclusions of the FMEA. The schedule is to include integration tests to verify that the response of the complete mechanical, hydraulic and electronic system is as predicted for all intended operational modes. The scope of these tests ~~shall~~ is to be agreed with LR for selected cases based on the FMEA required in (c).

(j) Evidence of type testing of the engine with electronic controls, or a proposed test plan at the engine builders with the electronic controls functioning, to verify the functionality and behaviour under ~~all~~ normal operating and fault conditions of the electronic control system.

Part 5, Chapter 4
Gas Turbines

Effective date 1 July 2010

~~■ *Section 9*~~
Planned maintenance and condition monitoring procedures, and 'upkeep by exchange'

9.1 Planned maintenance approach

9.1.1 Suitable gas turbine installation Planned Maintenance and Condition Monitoring Schemes (MPMS, MCM) will be accepted as part of LR's Continuous Survey Machinery (CSM) cycle provided the principles defined in 9.2 to 9.4 are satisfied, *see also* Chapter 21.

9.2 Preventive maintenance

9.2.1 Preventive maintenance requires items to be opened out for inspection and overhaul at specified time periods or after a specified number of running hours.

9.2.2 Maintenance is normally carried out irrespective of the condition of the gas turbine in order to retain it in a satisfactory operational condition.

9.3 Unscheduled maintenance

9.3.1 The planned maintenance scheme is to be capable of dealing effectively with breakdown or corrective maintenance, i.e. unscheduled maintenance.

9.4 Condition monitoring

9.4.1 Condition monitoring requires the use of instrumentation to make regular or continuous measurements of certain parameters, in order to indicate the physical state of the gas turbine, without disturbing its normal operation.

9.4.2 The data collected is to be used to determine the actual condition of the gas turbine at any given time or, based on the trend characteristics of the condition, used for predicting the remaining useful life before complete deterioration or loss of performance terminates its ability to carry out its required function.

Table 4.9.1 Condition monitoring techniques

Method	Requirement
Visual inspection	Periodic inspection of intakes and exhaust ducts, inlet guide vanes, compressor 1st stage, compressor and gas generator casings and auxiliary components and systems. The running clearances and dimensional changes, where practicable
Visual inspection by borescope/endoscope	Periodic inspection of compressor stators, guide vanes and blades, combustion chambers, turbine nozzles and blades and power turbine
Vibration monitoring	Continuous monitoring and trend analysis of gas generator and power turbine rotor vibration. The equipment used for vibration measurement should be capable of determining vibration throughout the operating range of the gas turbine
Lubrication, oil trend analysis programme	• Periodic inspection of magnetic particle detectors (manual records and/or automatic recording via debris counters in oil scavenge lines) • Periodic inspection of oil filters • Periodic sampling and laboratory analysis of lubricant quality
Fuel quality	• Maintenance of fuel bunker/marine gas oil analysis records • Periodic sampling and laboratory analysis of fuel quality
Performance monitoring	Continuous monitoring and trend analysis of critical gas turbine operating parameters including: • Compressor conditions (inlet and exit temperature, delivery pressure and speed) • Power turbine (inlet entry temperature and speed) • Engine breather temperature • Low cycle fatigue counter *See* Note.
NOTE Manual recording and trend analysis methods may also be acceptable.	

9.5 Condition monitoring techniques

9.5.1 The condition monitoring techniques, to support the trend away from preventive maintenance, listed in Table 4.9.1 are considered the minimum acceptable to obviate the need for a fully opened out inspection of engine components at Periodical Survey.

9.5.2 Alternative arrangements to those in Table 4.9.1, which provide an equivalent level of confidence in the condition of the gas turbine installation, will be considered.

9.6 Upkeep by exchange

9.6.1 Where the gas turbine is maintained using an 'upkeep by exchange' policy, details of the system are to be submitted to LR for approval.

9.6.2 Where an 'upkeep by exchange' system has been approved, details of units that can be changed independently of each other are not required to be submitted provided there have been no changes since the original approval. The manufacture and testing of the replacement units are to be in accordance with relevant Rule requirements.

9.6.3 Records of each 'upkeep by exchange' are to be kept on board the ship and LR Surveyors are to witness running tests on load after each exchange. A record history is to be maintained for each exchange unit in the engine logbook.

Part 5, Chapter 5
Gearing

Effective date 1 July 2010

■ *Scope*

The requirements of this Chapter, except where otherwise stated are applicable to oil engine gearing for main propulsion purposes and for oil engine gearing for driving auxiliary machinery which is essential for the safety of the ship or for safety of persons on board where the transmitted powers exceed 220 kW (300 shp) for propulsion drives, and 110 kW (150 shp) for auxiliary drives. Alternatively calculations using the methods defined in ISO 6336 – *Calculation of load capacity of spur and helical gears*, will be considered. In any mesh, the terms pinion and wheel refer to the smaller and larger gear respectively. For turbine gearing the loading factors K_A, $K_{F\alpha}$, $K_{F\beta}$, $K_{H\alpha}$, $K_{H\beta}$ and K_γ will be ~~specially~~ considered. Bevel gears will be specially considered on the basis of a conversion to equivalent helical gears. For torsional vibration requirements, *see* Ch 8,2.3.

■ *Section 1*
Plans and particulars

1.1 Gearing plans

1.1.1 Particulars of the gearing are to be submitted with the plans for all propulsion gears and for auxiliary gears where the transmitted power exceeds 110 kW (150 shp), as follows:

(a) Plans and information demonstrating conformance with the applicable Rules and Standards as stated in scope.
- (b) Shaft power and revolution for each pinion.
- (c) Number of teeth in each gear.
- (d) Reference diameters.
- (e) Helix angles at reference diameters.
- (f) Normal pitches of teeth at reference diameters.
- (g) Tip diameters.
- (h) Root diameters.
- (j) Face widths and gaps, where applicable.
- (k) Pressure angles of teeth (normal or transverse) at reference diameters.
- (l) Accuracy grade Q in accordance with ISO 1328 or an equivalent Standard.
- (m) Surface texture of tooth flanks and roots.
- (n) Minimum backlash.
- (o) Centre distance.
- (p) Basic rack tooth form.
- (q) Protuberance and final machining allowance.
- (r) Details of post hobbing processes, if any.
- (s) Details of tooth flank corrections, if adopted.
- (t) Case depth for surface-hardened teeth.
- (u) Shrinkage allowance for shrunk-on rims and hubs.
- (v) Type of coupling proposed for oil engine applications.

■ *Section 3*
Design

3.1 Symbols

(*Part only shown*)

3.1.1 For the purposes of this Chapter the following symbols apply:

h_F = bending moment arm for root stress, in mm

h_W = sum of actual tooth addenda of pinion and wheel, in mm

m_n = normal module, in mm

Q = accuracy grade derived from ISO 1328 ~~— 1975~~ *Cylindrical gears – ISO system of accuracy*

3.4 Tooth loading for surface stress

Table 5.3.4 Factors of safety

	$S_{H\,min}$	$S_{F\,min}$
Main propulsion gears	1,4	1,8
~~Main propulsion gears for yachts and small craft, single screw~~	~~1,25~~	~~1,50~~
~~Main propulsion gears for yachts and small craft, multiple screw~~	~~1,20~~	~~1,45~~
Auxiliary gears	1,15	1,40

~~NOTE~~
~~For the purposes of the above, yachts and small craft are considered to be pleasure craft not engaged in trade, passenger carrying or intended for charter service. Small craft are considered to be generally not greater than 24 m in length.~~

■ *Section 5*
Tests

5.3 Backlash

5.3.1 The normal backlash between any pair of gears should not be less than:

$$\frac{a\alpha_n}{90\,000} + 0{,}1 \text{ mm}$$

5.3.2 The normal backlash is not to exceed three times the value calculated in 5.3.1.

~~5.3~~ 5.4 Alignment

Existing sub-Section 5.3 *has been renumbered* 5.4.

Part 5, Chapter 8
Shaft Vibration and Alignment

Effective date 1 July 2010

■ *Section 2*
Torsional vibration

2.3 Scope of calculations

2.3.3 The calculations carried out on oil engine systems are to be based on the Enginebuilders' harmonic torque data ~~(on request, Lloyd's Register (hereinafter referred to as 'LR') can provide a table of generalised harmonic torque components for use where appropriate)~~. The calculations are to take account of the effects of engine malfunctions commonly experienced in service, such as a cylinder not firing (i.e. no injection but with compression) giving rise to the highest torsional vibration stresses in the shafting. Calculations are also to take account of a degree of imbalance between cylinders, which is characteristic of the normal operation of an engine under service conditions.

Part 5, Chapter 9
Podded Propulsion Units

Effective date 1 July 2010

■ *Section 2*
General requirements

2.2 Plans and information to be submitted

(*Part only shown*)

2.2.1 In addition to the plans required by Chapters 5, 6, 7, 8, 14 and 19, and Pt 6, Ch 1 and Ch 2, the following plans and information are required to be submitted for appraisal:

(z) Quality plan for electronic control systems and electrical actuating systems.

■ *Section 8*
Control engineering ~~arrangements~~ systems

8.1 General

8.1.8 For electronic control systems and electrical actuating systems, ~~the~~ an overall quality plan for sourcing, design, installation and testing ~~of components~~ is to address the following issues:

(a) Standard(s) applied.

(b) Details of the quality control system applied during manufacture and testing.

(c) Details of type approval, type testing or approved type status assigned to the equipment.

(d) Details of installation and testing recommendations for the equipment.

(e) Details of any local and/or remote diagnostic arrangements where assessment and alteration of control parameters can be made which can affect the operation of the podded propulsor unit.

(f) Software lifecycle activities, including configuration management and ~~Details of~~ arrangements for software upgrades.

8.1.9 The ~~system integration plan is required~~ quality plan referred to in 8.1.8 to identify the process for verification of the functional outputs from the electronic control systems with particular reference to system integrity, consistency, security against unauthorised changes to software and maintaining the outputs within acceptable tolerances of stated performance for safe and reliable operation of the podded propulsor unit.

8.2 Monitoring and alarms

Table 9.8.1 Specific alarms for pod control systems (*Part only shown*)

Item	Alarm	Note
Propulsion motors	Overload, power failure	To be indicated on the navigating bridge
Propulsion motor power limitation or automatic reduction	Activated	*See also* 8.2.8
Hydraulic oil system pressure	Low	To be indicated on the navigating bridge

8.2.8 Means are to be provided to identify the cause of propulsion motor power limitation or automatic reduction.

Part 5, Chapter 10

Steam Raising Plant and Associated Pressure Vessels

Effective date 1 July 2010

■ *Section 1* General requirements

1.13 Exhaust gas economiser/boiler arrangements

1.13.1 The design of exhaust gas economisers/boilers of the plain or extended surface fin tube types is to be compatible with the installed engine design parameters. The parameters which influence the build up of soot deposits and overheating such as fuel, exhaust gas temperature and efflux velocity are to be considered in the design of the exhaust gas economiser/boiler for use with the installed engine, in order to minimise the risk of fire and breakdown during operation.

1.13.2 A design statement demonstrating compliance with the requirements of 1.13.1 or alternative means of preventing the accumulation of soot or overheating, such as the use of exhaust gas bypass ducting with automatic flap valve arrangements and/or effective soot prevention and cleaning systems, is to be submitted for approval.

■ *Section 15* Mountings and fittings for cylindrical and vertical boilers, steam generators, pressurised thermal liquid and pressurised hot water heaters

15.2 Safety valves

15.2.8 Each safety valve chest is to be drained by a pipe fitted to the lowest part and led with a continuous fall to the bilge or to a tank, clear of the boilers. No valves or cocks are to be fitted to these drain pipes. ~~It is recommended that the~~ The bore of the drain pipes is to be not less than 19 mm.

15.2.10 To avoid the accumulation of solid matter deposits on the outlet side of the safety valves and bursting discs required by 15.2.9, the discharge pipes and safety valve/bursting disc housings are to be fitted with drainage arrangements from the lowest part, directed with continuous fall to a position clear of the economiser where it will not pose a threat to either personnel or machinery. No valves or cocks are to be fitted in the drainage arrangements. The drainage arrangements required by 15.2.8 may be accepted as meeting these requirements where the arrangements comply with this paragraph.

15.2.15 Pressurised thermal liquid and pressurised hot water heaters are to be provided with a safety relief device. The safety valve is to be designed and constructed in accordance with a relevant National or International Standard acceptable to LR.

Part 5, Chapter 12
Piping Design Requirements

Effective date 1 July 2010

■ *Section 1*
General

1.6 Materials

1.6.2 The manufacturer's ~~test~~ certificate validated by LR for materials for pipes, valves and fittings of Class I and Class II piping systems will be accepted in lieu of LR's materials certificate where the maximum conditions are less than shown in Table 12.1.2. *See* Ch 1,3.1.3(b) of the Rules for Materials.

1.6.3 The manufacturer's ~~test~~ certificate validated by LR for materials for ship-side valves and fittings and valves on the collision bulkhead equal to or less than 500 mm nominal diameter will be accepted in lieu of LR's materials certificate where the valves and fittings are in accordance with a recognised National Standard applicable to the intended application and are manufactured and tested in accordance with the appropriate requirements of the Rules for Materials. *See* Ch 1,3.1.3(b) of the Rules for Materials.

■ *Section 2*
Carbon and low alloy steels

2.1 Carbon and low alloy steel pipes, valves and fittings

2.1.2 Materials for Class III piping systems are to be manufactured and tested in accordance with the requirements of acceptable national specifications. Pipes having forge butt welded longitudinal seams are not to be used for oil fuel systems, for heating coils in oil tanks, or for pressures exceeding 4,0 bar (4,1 kgf/cm^2). The manufacturer's ~~test~~ certificate will be acceptable and is to be provided for each consignment of material. *See* Ch 1,3.1.3(c) of the Rules for Materials.

2.2 Wrought steel pipes and bends

2.2.5 Where the minimum thickness calculated by 2.2.3 or 2.2.4 is less than that shown in Table 12.2.4, the minimum nominal thickness for the appropriate standard pipe size shown in the Table is to be used. No allowance is required for negative tolerance, corrosion or reduction in thickness due to bending on this nominal thickness. For larger diameters, the minimum thickness will be ~~specially~~ considered. For threaded pipes, where permitted, the minimum thickness is to be measured at the bottom of the thread.

■ *Section 3*
Copper and copper alloys

3.1 Copper and copper alloy pipes, valves and fittings

3.1.2 Materials for Class III piping systems are to be manufactured and tested in accordance with the requirements of acceptable National Specifications. The manufacturer's ~~test~~ certificate will be acceptable and is to be provided for each consignment of material. *See* Ch 1,3.1.3(c) of the Rules for Materials.

■ *Section 4*
Cast iron

4.1 Spheroidal or nodular graphite cast iron

4.1.3 Castings for Class II systems, also for ship-side valves and fittings and valves on the collision bulkhead, are to be manufactured and tested in accordance with the requirements of Chapter 7 of the Rules for Materials. ~~Castings for Class III systems are to comply with the requirements of acceptable national specifications. A manufacturer's test certificate will be accepted and is to be provided for each consignment of material for Class III systems, *see also* 1.6.~~

4.1.4 Castings for Class III systems are to comply with the requirements of acceptable national specifications. A manufacturer's certificate will be accepted and is to be provided for each consignment of material for Class III systems, *see also* 1.6 and Ch 1,3.1.3(c) of the Rules for Materials.

Existing paragraphs 4.1.4 *and* 4.1.5 *have been renumbered* 4.1.5 *and* 4.1.6.

■ *Section 5*
Plastics pipes

5.2 Design and performance criteria

5.2.4 Plastics piping, connections and fittings are ~~is~~ to be electrically conductive when:

(a) carrying fluids capable of generating electrostatic charges.
(b) passing through ~~dangerous~~ hazardous zones and spaces, regardless of the fluid being conveyed.

Suitable precautions against the build up of electrostatic charges are to be provided in accordance with the requirements of 5.5, *see also* Pt 6, Ch 2,1.12.

CORRIGENDA

■ *Section ~~11~~ 10*
Austenitic stainless steels

Existing Section 11 *has been renumbered* Section 10.

■ *Section ~~10~~ 11*
Guidance notes on metal pipes for water services

Existing Section 10 *has been renumbered* Section 11.

Part 5, Chapter 13
Ship Piping Systems

Effective date 1 July 2010

■ *Section 1*
General requirements

1.1 Application

1.1.2 Whilst the requirements satisfy the relevant regulations of the *International Convention for the Safety of Life at Sea, 1974*, and applicable amendments, attention should be given to any relevant regulations of the *International Convention for the Prevention of Pollution from Ships, 1973,* and applicable amendments, where these impact the design or construction of piping systems. Attention should also be given to any relevant statutory requirements of the National Authority of the country in which the ship is to be registered.

1.3 Plans and particulars

(*Part only shown*)

1.3.1 The following plans (in diagrammatic form) and particulars are to be submitted for approval. Additional plans should not be submitted unless the arrangements are of a novel or special character affecting classification:

(y) For water ingress detection arrangements, *see* Section 14, plans and information in accordance with Pt 6, Ch 1,1.2 and, additionally, general arrangement plans showing the spaces provided with water ingress detectors, installed equipment locations and cable routes. Details of National Administration approvals are to be included.

■ *Section 3*
Drainage of compartments, other than machinery spaces

3.1 General

3.1.6 For a normally inaccessible small void compartment such as an echo sounding compartment, which is accessed from within a normally inaccessible space such as a forepeak tank, alternative drainage arrangements to those required by 3.1.1 may be considered. For such arrangements, a warning notice is to be located in a prominent position specifying the precautions to be taken prior opening the manhole of the small void compartment. Means are to be provided to indicate flooding of the compartment without opening, such as fitting indicator plugs to the manhole. Drainage arrangements are to be submitted to LR for approval.

■ *Section 4*
Bilge drainage of machinery spaces

■ *Section 6*
Pumps on bilge service and their connections

6.1 Number of pumps

6.1.7 Where the bilge pumps required by 6.1.1 or 6.1.5 are installed in spaces not fitted with a double bottom, the pumps are to be either:

(a) capable of operating in flooded spaces; or

(b) located in separate watertight compartments.

■ *Section 7*
Piping systems and their fittings

7.1 Main bilge line suctions

7.1.1 Suctions from the main bilge line, i.e. branch bilge suctions, are to be arranged to draw water from any hold, compartment, watertight section or machinery compartment of the ship, excepting small spaces such as those mentioned in 3.1.6, 3.5 and 3.6, where manual pump suctions are accepted, and are not to be of smaller diameter than that required by the formula in 5.2.1, *see also* 7.4.1 and 7.5.1. For special arrangements for oil tankers, *see* Chapter 15.

7.5 Hold and other compartment suctions – Strum boxes

7.5.1 The open ends of bilge suctions in holds and other compartments outside machinery spaces and tunnels such as cofferdams and tanks other than those permanently arranged for the carriage of fresh water, water ballast, oil fuel or liquid cargo and for which other efficient means of pumping are provided are to be enclosed in strum boxes having perforations of not more than 10 mm diameter, whose combined area is not less than twice that required for the suction pipe. The boxes are to be so constructed that they can be cleared without breaking any joint of the suction pipe.

■ *Section 8*
Additional requirements for bilge drainage and cross-flooding arrangements for passenger ships

8.1 Location of bilge pumps and bilge main

8.1.1 In passenger ships, the power bilge pumps required by 6.1.5 are to be placed, if practicable, in separate watertight compartments which will not readily be flooded by the same damage. If the engines and boilers are in two or more watertight compartments, the bilge pumps are to be distributed throughout these compartments so far as is possible. *See also* 6.1.7.

8.1.2 In passenger ships of 91,5 m or more in length, or having a bilge pump numeral of 30 or more (*see* 6.1.5 and 6.1.7), the arrangements are to be such that at least one power pump will be available for use in all ordinary circumstances in which the ship may be flooded at sea. This requirement will be satisfied if:

- one of the pumps is an emergency pump of a submersible type having a source of power situated above the bulkhead deck, or
- the pumps and their sources of power are so disposed throughout the length of the ship that, under any conditions of flooding which the ship is required by statutory regulation to withstand, at least one pump in an undamaged compartment will be available.

■ *Section 12*
Air, overflow and sounding pipes

12.4 Air pipes

12.4.3 For a normally inaccessible small void compartment such as an echo sounding compartment, which is accessed from within a normally inaccessible space such as a forepeak tank, alternative air pipe arrangements to those required by 12.4.1 may be considered. For such arrangements, a warning notice is to be located in a prominent position specifying the precautions to be taken prior opening the manhole and entering the small void compartment. Ventilation arrangements are to be submitted to LR for approval.

12.11 Sounding arrangements

12.11.8 For a normally inaccessible small void compartment such as an echo sounding compartment, which is accessed from within a normally inaccessible space such as a forepeak tank, alternative sounding arrangements to those required by 12.11.1 may be considered. For such arrangements, a warning notice is to be located in a prominent position specifying precautions to be taken prior opening the manhole of the small void compartment. Means are to be provided to indicate flooding of the compartment without opening, such as fitting indicator plugs to the manhole. Sounding arrangements are to be submitted to LR for approval.

■ *Section 13*
Additional requirements for drainage and pumping arrangements for bulk carriers

13.1 General requirements

13.1.1 Arrangements for drainage and pumping are to be in accordance with the requirements of SOLAS 1974 as amended, Chapter XII, Regulation 13.

13.1.2 On bulk carriers, the means for draining and pumping ballast tanks forward of the collision bulkhead and bilges of dry spaces any part of which extends forward of the foremost cargo hold are to be capable of being brought into operation from a readily accessible enclosed space, the location of which is accessible from the navigation bridge or propulsion machinery control positions without traversing exposed freeboard or superstructure decks. Wher pipes serving such tanks or bilges pierce the collision bulkhead, valve operation by means of remotely operated actuators may be accepted, as an alternative to the valve control specified in 3.5.4, provided that the location of such valve controls complies with this requirement.

13.2 Dewatering capability

13.2.1 The dewatering system for ballast tanks located forward of the collision bulkhead, and for bilges of dry spaces any part of which extends forward of the foremost cargo hold, is to be designed to remove water from the forward spaces at a rate of not less than $320A$ m^3/h, where A is the cross-sectional area in m^2 of the largest air pipe or ventilator pipe connected from the exposed deck to a closed forward space that is required to be dewatered by these arrangements.

■ *Section 14*
Water ingress detection arrangements

14.1 General requirements

14.1.1 Equipment for detecting the ingress of water in bulk carriers is to be fitted in accordance with the requirements of SOLAS 1974 as amended, Chapter XII, Regulation 12.

14.1.2 Equipment for detecting the ingress of water in single hold cargo ships is to be fitted in accordance with the requirements of SOLAS 1974 as amended, Chapter II-1, Regulation 25.

14.1.3 Flooding detection systems in passenger ships carrying 36 persons or more are to be fitted in accordance with the requirements of SOLAS 1974 as amended, Chapter II-1, Regulation 22-1.

14.1.4 Alarm and indicators specified in 14.2 to 14.4 are to be provided on the navigation bridge and, for passenger ships, additionally in the safety centre if located in a separate space from the navigation bridge.

14.1.5 Equipment required by 14.1.2 to 14.1.4 is to satisfy the applicable requirements of Pt 6, Ch 1.

14.1.6 Pt 6, Ch 1,1.3.1 details applicable requirements for Survey at the manufacturer's works. At the initial installation and during each subsequent Complete Survey of Machinery alarm systems or Special Survey, the operation of the ingress detection arrangements is to be demonstrated to the satisfaction of the LR Surveyor.

14.1.7 Where alternative arrangements to those required by 14.1.2 to 14.1.4 are proposed, evidence is to be submitted for consideration by LR that demonstrates:

- water ingress will be detected in all areas considered necessary to reliably detect flooding of watertight spaces;
- responsible personnel will be effectively notified in the event of water ingress to allow for planned response; and
- acceptance by the National Administration with which the ship is registered.

14.2 Water ingress detection arrangements in bulk carriers

14.2.1 Bulk carriers are to be fitted with water level detectors:

(a) in each cargo hold, giving audible and visual alarms, one when the water level above the inner bottom in any hold reaches a height of 0,5 m and another at a height not less than 15 per cent of the depth of the cargo hold but not more than 2 m. The water level detectors are to be fitted in the aft end of each cargo hold. For cargo holds which are used for water ballast, an alarm overriding device may be installed. The visual alarms are to clearly discriminate between the two different water levels detected in each hold;

(b) in any ballast tank forward of the collision bulkhead required by Pt 3, Ch 3,4, giving an audible and visual alarm when the liquid in the tank reaches a level not exceeding 10 per cent of the tank capacity. An alarm overriding device may be installed to be activated when the tank is in use; and

(c) in any dry or void space other than a chain cable locker, any part of which extends forward of the foremost cargo hold, giving an audible and visual alarm at a water level of 0,1 m above the deck. Such alarms need not be provided in enclosed spaces the volume of which does not exceed 0,1 per cent of the ship's maximum displacement volume.

14.3 Water ingress detection arrangements in single hold cargo ships

14.3.1 Ships having a length, L, of less than 80 m and a single cargo hold below the freeboard deck or cargo holds below the freeboard deck which are not separated by at least one bulkhead made watertight up to that deck, are to be fitted in such space or spaces with water level detectors.

14.3.2 The water level detectors required by 14.3.1 are to:

(a) give an audible and visual alarm when the water level above the inner bottom in the cargo hold reaches a height of not less than 0,3 m, and another when such level reaches not more than 15 per cent of the mean depth of the cargo hold; and

(b) be fitted at the aft end of the hold, or above its lowest part where the inner bottom is not parallel to the designed waterline. Where webs or partial watertight bulkheads are fitted above the inner bottom, the installation of additional detectors is to be considered.

14.3.3 The water level detectors required by 14.3.1 need not be fitted in ships complying with 14.2, or in ships having watertight side compartments each side of the cargo hold length which extend vertically at least from inner bottom to freeboard deck.

14.4 Flooding detection systems in passenger ships

14.4.1 Passenger ships for 36 persons or more are to be provided with a flooding detection system for watertight spaces below the bulkhead deck.

14.4.2 The flooding detection system required by 14.4.1 is to be fitted in all watertight spaces below the bulkhead deck that:

(a) have a volume, in cubic metres, that is more than the ship's moulded displacement per centimetre immersion at deepest subdivision draught; or

(b) have a volume more than 30 cubic metres, whichever is the greater.

14.4.3 Any watertight spaces that are individually equipped with a liquid level monitoring system (such as fresh water, ballast water, fuel, etc.), including an indicator panel or other means of monitoring at the navigation bridge, and the safety centre if located in a separate space from the navigation bridge, are excluded from the requirements of this sub-Section.

14.4.4 The number and location of flooding detection sensors is to be sufficient to ensure that any substantial water ingress into a watertight space requiring a flooding detection system is detected under reasonable angles of trim and heel. To accomplish this, flooding detection sensors are to be installed as indicated below:

(a) **Vertical location** – sensors are to be installed as low as practical in the watertight space;

(b) **Longitudinal location** – in watertight spaces located forward of the mid-length sensors are generally to be installed at the forward end of the space; and in watertight spaces located aft of the mid-length, sensors are generally to be installed at the aft end of the space. For watertight spaces located in the vicinity of the mid-length, consideration is to be given to the appropriate longitudinal location of the sensor. In addition, any watertight space of length more than 20 per cent of the ship's subdivision length or with arrangements that would seriously restrict the longitudinal flow of water is to be provided with sensors at both the forward and aft ends; and

(c) **Transverse location** – sensors are generally to be installed at the centreline of the space (or alternatively at both the port and starboard sides). In addition, any watertight space that extends the full breadth of the ship or with arrangements that would seriously restrict the transverse flow of water is to be provided with sensors at both the port and starboard sides.

14.4.5 Where a watertight space extends in height over more than one deck, there is to be at least one flooding detection sensor at each deck level. This provision is not applicable in cases where a continuous flood level monitoring system is installed.

14.4.6 Consideration may be given to the number and location of flooding detection sensors in watertight spaces with unusual arrangements or in other cases where these requirements would not achieve the intended purpose, *see* 14.1.7.

Part 5, Chapter 14
Machinery Piping Systems

Effective date 1 July 2010

■ *Section 5*
Steam piping systems

5.3 Soot cleaning drains

5.3.1 The capacity of the drains from exhaust gas economisers/boilers is to be sufficient to remove all wash water or condensate generated by installed washing systems and arrangements are to be such that engines and turbochargers are protected from wash water or condensate drainage from the washing system.

5.3.2 Adequate arrangements are to be made for the collection and disposal of the waste water generated during periodic water washing of the exhaust gas economiser/boiler. Details are to be submitted for approval.

Existing sub-Sections 5.3 *to* 5.5 *have been renumbered* 5.4 *to* 5.6.

■ *Section 6*
Boiler feed water ~~and~~, condensate and thermal fluid circulation systems

6.2 Feed and circulation pumps

6.2.5 The arrangement of forced water/thermal fluid circulation pumps for exhaust gas economisers/boilers/thermal heaters is to be such that where required, the flow through the exhaust gas economiser/boiler/thermal heater is to be established prior to engine start up. Where applicable, provision is to be made to allow for operation in the dry condition.

6.2.6 The forced circulation flow required by 6.2.5 is to be maintained on completion of engine shutdown for a sufficient duration in accordance with the exhaust gas economiser/boiler/thermal heater manufacturer's instructions. Details of arrangements are to be submitted for approval.

6.2.7 Where arrangements are such that exhaust gas economisers/boilers/thermal heaters require forced water /thermal fluid circulation, standby pumps are to be fitted, *see* Pt 6, Ch 1,3.1.3.

■ *Section 10*
Low pressure compressed air systems

10.1 General

10.1.1 The requirements of this Section are applicable to low pressure (LP) compressed air systems which are essential for pneumatic control and instrumentation purposes. The documentation required by Ch 13,1.3.1 is to provide information to demonstrate compliance with 10.1.2 to 10.1.5.

Part 5, Chapter 15
Piping Systems for Oil Tankers

Effective date 1 July 2010

■ *Section 1*
General requirements

1.5 ~~Dangerous spaces~~ Hazardous zones and spaces

1.5.2 For definition of ~~dangerous~~ hazardous zones ~~or~~ and spaces and requirements for electrical equipment within such spaces, *see* Pt 6, Ch 2,~~13.4~~ 13.5.

■ *Section 2*
Piping systems for bilge, ballast, oil fuel, etc.

2.1 Pumping arrangements at ends of ship outside ~~dangerous~~ hazardous zones and spaces

2.1.2 Bilge, ballast and oil fuel lines, etc., which are connected to pumps, tanks or compartments at the ends of the ship outside ~~dangerous~~ hazardous zones and spaces, are not to pass through cargo tanks or have any connections to cargo tanks, or cargo piping. No objection will be made to these lines being led through ballast tanks or void spaces within the range of the cargo tanks.

2.1.4 Where non-permanent connections are required in piping systems between ~~non-dangerous~~ non-hazardous and ~~dangerous~~ hazardous spaces, two means of isolation are to be provided. One of these means is to provide positive separation by means of a removable spool piece or flexible hose, and blank flanges are to be fitted. The other is to be a non-return valve, or similar, in accordance with an acceptable National or International Standard that is appropriate for the design conditions of the piping system. ~~The non-return valve and removable piece are to be located outside the non-dangerous space.~~ The non-return valve and removable piece are to be located within the existing hazardous spaces. A notice is also to be provided located in a prominent position adjacent to the means of isolation, clearly indicating that the spool piece or flexible hose is to be removed, and blanking flanges are to be fitted, when the piping is not in use. The removable spool piece is to be clearly identified (labelled/painted in a distinctive colour) and stowed close to its working position.

■ *Section 3*
Cargo handling system

3.5 Bow or stern loading and discharge arrangements

3.5.2 The spaces within ~~3 m~~ 4,5 m of flanged connections to, or valves or drip trays associated with, discharge manifolds discharge manifolds are to be considered as ~~dangerous~~ hazardous spaces with regard to electrical or incendive equipment, *see also* Pt 6, Ch 2,~~13.9~~ 13.10.

3.8 Cargo handling controls

3.8.1 Electrical measuring, monitoring control and communication circuits located in ~~dangerous~~ hazardous spaces are to be ~~intrinsically safe~~ in accordance with Pt 6, Ch 2,13.2, appropriate to the defined hazardous zone.

Part 5, Chapter 21
ShipRight Procedures for Machinery Planned Maintenance and Condition Monitoring, and Requirements for Condition Monitoring Systems

Effective date 1 July 2010

■ *Section 1*
General

1.2 Classification notations and descriptive notes

1.2.1 In addition to the machinery class notations defined in Pt 1, Ch 2, ships complying with the requirements of this Chapter will be eligible to be assigned the descriptive notes as defined in Pt 1, ~~Ch 2,2.6~~ Ch 2,2.7 and associated with the ShipRight procedures.

1.3 ~~Information and plans required to be submitted~~ Plans and particulars

1.3.2 In addition to information required by 1.3.1, the documents listed in the *ShipRight Procedures for Machinery Planned Maintenance and Condition Monitoring* are to be submitted to LR for consideration.

1.3.3 Equipment type approval reports providing evidence of compliance with 7.2.1 and 7.2.2.

1.3.4 Additional information and plans providing evidence of compliance with the requirements of 7.2.3, 7.3.1 and 7.4.3.

■ *Section 2*
Machinery Planned Maintenance Scheme

2.1 Descriptive note MPMS

2.1.3 For the requirements and approval procedures, *see* ~~the appropriate procedures in~~ the *ShipRight Procedures ~~Overview~~ for Machinery Planned Maintenance and Condition Monitoring*.

■ *Section 3*
Machinery Condition Monitoring

3.1 Descriptive note MCM

3.1.3 For the design and installation of machinery condition monitoring systems which form part of a machinery planned maintenance scheme approved by LR for the assignment of the **MCM** descriptive note, the requirements of Section 7 are applicable.

~~*3.1.3*~~ *3.1.4* For the requirements and approval procedures, *see* ~~the appropriate procedures in~~ the *ShipRight Procedures ~~Overview~~ for Machinery Planned Maintenance and Condition Monitoring*.

■ *Section 4*
Turbine Condition Monitoring

4.1 Descriptive note TCM

4.1.3 For the requirements, *see* ~~the appropriate procedure in~~ the *ShipRight Procedures ~~Overview~~ for Machinery Planned Maintenance and Condition Monitoring*.

■ *Section 5*
Screwshaft Condition Monitoring

5.1 Descriptive note SCM

5.1.3 For the requirements, *see* Pt 1, Ch 3,17.3 and ~~the appropriate procedure in~~ the *ShipRight Procedures ~~Overview~~ for Machinery Planned Maintenance and Condition Monitoring*.

■ *Section 6*
Reliability Centred Maintenance

6.1 Descriptive note RCM

6.1.3 For the requirements and approval procedures, *see* ~~the appropriate procedures in~~ the *ShipRight Procedures ~~Overview~~ for Machinery Planned Maintenance and Condition Monitoring*.

■ *Section 7*
Requirements for Condition Monitoring Systems

7.1 Scope

7.1.1 The requirements of this Chapter are applicable to condition monitoring systems which:

(a) provide control, alarm or safety functions for essential machinery and equipment (*see* Pt 6, Ch 1,2.1.1) in accordance with manufacturers recommendations; or

(b) provide machinery condition related information as part of a machinery planned maintenance scheme for use as an alternative to machinery and equipment surveys required by the Regulations (*see* Pt 1, Ch 3) in accordance with LR's ShipRight procedures.

7.1.2 Condition monitoring systems which deviate from the requirements of this Section but provide an equivalent level of performance may be submitted to LR for consideration.

7.1.3 The requirements of this Section are to be applied to condition monitoring systems where the assignment of the **MCM** descriptive note is requested.

7.2 General requirements for condition monitoring systems

7.2.1 Condition monitoring equipment is to be capable of providing the service for which it is intended and is to satisfy the relevant requirements for condition monitoring equipment in LR's Type Approval System, *Product Assessment and Test Specification* (*TACM*).

7.2.2 Condition monitoring equipment is to be suitable for the environment in which it is intended to operate and is to satisfy the relevant requirements for environmental testing in LR's Type Approval System, *Test specification No.1*.

7.2.3 The installation of condition monitoring equipment in spaces and locations in which flammable mixtures are liable to collect, e.g. areas containing flammable gas or vapour and/or combustible dust, is to be minimised as far as is practicable and is to satisfy the relevant requirements for the use of electrical equipment in flammable atmospheres in Pt 6, Ch 2,13.

7.2.4 Where permanently installed condition monitoring systems are used, the cables are to comply with the relevant Sections of Pt 6, Ch 2,10 and the piping systems are to comply with relevant Sections of Chapters 12 and 13.

7.2.5 Where the system is based on programmable electronic systems, the requirements of Pt 6, Ch 1,2.10.21 are to be complied with.

7.3 Requirements for systems providing control, alarm and safety functions

7.3.1 In addition to the requirements of 7.2, condition monitoring equipment which provides control, alarm or safety functions for essential machinery and equipment is also to satisfy the relevant requirements for control, alarm and safety systems in Pt 6, Ch 1 and the installation of electrical equipment in Pt 6, Ch 2.

7.4 Requirements for systems providing machinery condition related information as part of machinery planned maintenance scheme

7.4.1 In addition to the requirements of 7.2, condition monitoring equipment which provides machinery condition related information as part of a machinery planned maintenance scheme for use as an alternative to machinery and equipment surveys required by the Regulations is also to satisfy the relevant requirements of LR's *ShipRight Procedures for Machinery Planned Maintenance and Condition Monitoring*.

7.4.2 The condition monitoring equipment is, as far as is practicable, to be located and installed such that it is accessible for maintenance and survey.

7.4.3 The condition monitoring equipment is to be installed in accordance with the manufacturer's instructions, *see* the *Product Assessment and Test Specification* (*TACM*) or by an approved technical organisation as defined in the *ShipRight Procedures for Machinery Planned Maintenance and Condition Monitoring*, and to the satisfaction of the LR Surveyor.

Part 5, Chapter 22
Propulsion and Steering Machinery Redundancy

Effective date 1 July 2010

■ *Section 2*
Failure Mode and Effects Analysis (FMEA)

2.1 General

2.1.7 The FMEA is to establish that in the event of a single ~~component~~ failure:

(a) for **PSMR** and **PSMR★** notations, that the ship will retain not less than 50 per cent of the installed prime mover capacity and not less than 50 per cent of the installed propulsion systems and retain steering capability;

(b) for **PMR** and **PMR★** notations, that the ship will retain not less than 50 per cent of the installed prime mover capacity and not less than 50 per cent of the installed propulsion systems;

(c) for **SMR** and **SMR★** notations, that the steering capability remains available;

(d) ~~For~~ for **PSMRL★** notation, that the ship will retain the ability to use available installed prime mover capacity and installed propulsion systems that are not directly affected by the failure and retain steering capability at a service speed of not less than seven knots; and

(e) ~~For~~ for **PMRL★** notation, that the ship will retain the ability to use available installed prime mover capacity and installed propulsion systems that are not directly affected by the failure.

Part 5, Chapter 23

Safe Return to Port and Orderly Evacuation and Abandonment in Passenger Ships

Effective date 1 July 2010

■ *Section 1* General

1.1 Scope and application

1.1.1 The requirements of this Chapter are additional for passenger ships and are related to machinery and equipment providing services necessary to support safe return to port under the ship's own propulsion in the event of flooding or after a fire and to support orderly evacuation and abandonment in the event of a fire.

1.1.2 The requirements of this Chapter are restricted to machinery and equipment specifically addressed by relevant engineering systems Rules.

1.1.3 The performance of machinery and equipment for services referred to in the relevant SOLAS Regulations that are not specifically addressed by relevant engineering systems Rules are not considered (e.g. basic services to safe areas, radiocommunications, navigation systems, etc.). However, these services are to be considered in terms of:

(a) the supply of electrical power in accordance with SOLAS 1974, as amended; and
(b) protection provided to machinery and equipment described in 1.1.2 (e.g. fire suppression measures in spaces containing propulsion machinery).

1.1.4 For passenger ships having a length of 120 m or more, or having three or more main vertical zones, the requirements of Sections 1 to 5 apply. For other passenger ships, the requirements of Sections 2 and 4 are not applicable and the requirements of Section 3 may be restricted to the qualitative failure analysis described in 3.2.2.

1.1.5 These requirements do not address operational decisions on the actual use of machinery and equipment in the event of flooding or fire (e.g. the use of propulsion and steering in a flooding damage condition).

1.2 Definitions

1.2.1 For the purposes of this Chapter, 'the relevant SOLAS Regulations' refers to SOLAS 1974, as amended:

(a) Chapter II-1/B-1, Regulation 8-1, *System capabilities after a flooding casualty on passenger ships*;
(b) Chapter II-2/G ,Regulation 21, *Casualty threshold, safe return to port and safe areas*; and
(c) Chapter II-2/G ,Regulation 22, *Design criteria for systems to remain operational after a fire casualty*. (a) and (b) apply for Sections 2 and 3, (c) applies for Section 4.

1.2.2 For the purposes of this Chapter, 'relevant engineering systems Rules' refers to this Part (i.e. Part 5), Pt 6, Ch 1 and Pt 6, Ch 2.

1.2.3 The 'casualty threshold' in the context of a fire includes:

(a) loss of space of origin up to the nearest 'A' class boundaries, which may be a part of the space of origin, if the space of origin is protected by a fixed fire extinguishing system; or
(b) loss of the space of origin and adjacent spaces up to the nearest 'A' class boundaries, which are not part of the space of origin.

1.2.4 Ship lengths and main vertical zones considered are to be as defined by Pt 3, Ch 1,6.1.8 and SOLAS 1974, as amended Chapter II-2/A, Regulation 3.32, respectively.

1.2.5 'Safe areas' are those that will be available, during a ship's return to port under its own propulsion after a casualty that does not exceed the casualty threshold stipulated, to provide the basic services to ensure that the health of passengers and crew is maintained.

1.2.6 For the purposes of this Chapter, 'reversionary control stations' are those control stations provided for use during safe return to port and orderly evacuation and abandonment to satisfy the requirements of Sections 2 and 4 in the event of the normal control station being subject to fire damage or flooding.

1.2.7 A 'failure' is the termination of the ability of an item to perform a required function. For the purposes of Section 3:

(a) failures result from a fault in a component or system such that it cannot perform an intended or required function, including faults resulting from fire or flooding damage;
(b) 'common cause failures' are those failures which will cause more than one item to fail simultaneously, or within a sufficiently short period of time as to have the effect of simultaneous failures; and
(c) 'consequential failures' are secondary failures caused by the effects of a primary failure, i.e. where the occurrence of a failure leads directly to further failures.

1.3 General requirements and risk management

1.3.1 For passenger ships having a length of 120 m or more, or having 3 or more main vertical zones, it is the responsibility of the Shipbuilder to ensure that the arrangement of the ship's machinery and equipment as described in 1.1.2 are sufficient for the intended operating modes and to support the provision of the services that the National Administration has determined to be necessary for:

(a) the ship's safe return to port under its own propulsion, *see* Section 2:
    (i) after a casualty that does not exceed the casualty threshold; or
    (ii) when the ship is subject to flooding of any single watertight compartment; and/or
(b) supporting the orderly evacuation and abandonment of the ship if the casualty threshold is exceeded, *see* Section 4.

This necessitates activities, which will normally be risk based, to determine the machinery and equipment needed to remain operational for a period of time to satisfy the requirements of the relevant SOLAS Regulations to the satisfaction of the National Administration. These activities are to be carried out prior to the submission of plans in accordance with this Chapter.

1.3.2 The activities referred to in 1.3.1 may be conducted at the same time, or in conjunction with, activities to determine the criteria that the National Administration specify as necessary to achieve overall compliance with the relevant SOLAS Regulations. The ship's intended operational routes and/or service restrictions may be considered when establishing criteria.

1.3.3 It is the responsibility of the Shipbuilder to ensure that watertight and fire divisions, fire-fighting systems and bulkhead decks shown on the plans are those approved by the National Administration.

1.3.4 Where alternatives to the requirements of this Chapter are proposed, details demonstrating that the machinery and engineering systems comply with the relevant SOLAS Regulations are to be submitted for consideration.

1.4 Plans and information

1.4.1 In addition to the plans and information otherwise required by relevant engineering systems Rules, the plans and information detailed in 1.4.2 to 1.4.12 are to be submitted.

1.4.2 The analysis report described in 3.1.5(a) that includes the following information:

(a) identification of any applicable standards used for analysis of the design;
(b) description of the analysis team and their roles for information only;
(c) identification of the objectives of the analysis, including any National Administration acceptance criteria;
(d) identification of assumptions made in the analysis;
(e) description of intended system function under normal conditions and in the event of fire or flooding;
(f) identification of the equipment, system or sub-system and mode of operation, including the design plans and information considered;
(g) identification of casualty scenarios, probable failure modes and acceptable deviations from the intended or required function;
(h) evaluation of the local effects and the effects on the overall installation of each failure mode as applicable;
(j) identification of the worst case scenario in the event of a fire casualty or flooding, as described in 2.1.1, and an assessment of the ship's ahead and astern manoeuvring capability under these conditions (IMO Resolution MSC.137(76), *Standards for Ship Manoeuvrability*, provides standards to assess the manoeuvrability of ships); and
(k) trials, testing and other activities necessary to verify compliance with Section 3. The final report described in 3.1.5(b) is to be submitted once the proposed design is finalised.

1.4.3 Description of intended system function under normal conditions and in the event of fire or flooding for the services referred to in Sections 2 and 4.

1.4.4 Details of analyses conducted to assess the availability of services referred to in Sections 2 and 4 in the event of fire or flooding.

1.4.5 Details of National Administration criteria (*see also* 1.3.1), including:

(a) service speed, manoeuvring capability and time period of operation and ship range for ship return to port under its own propulsion;
(b) systems determined to be vital to damage control efforts;
(c) identification of required internal communications arrangements; and
(d) identification of navigation light circuits to be capable of operation during return to port.

1.4.6 General arrangement plans of the ship showing the location of machinery and equipment, piping systems, cables and controls stations to be employed for:

(a) each of the services described in 2.1.2, 2.1.3, and 4.1.2; and
(b) the provision of electrical power described in 2.1.4 and 4.1.3.

The plans are to identify:

(c) watertight compartments and the bulkhead deck; and
(d) for passenger ships having a length of 120 m or more or having three or more main vertical zones:
    (i) safe areas in the context of a casualty; and
    (ii) casualty threshold 'A' class structural fire protection boundaries.

The plans are to indicate segregation and fire/flooding protection measures and access arrangements for machinery spaces and associated control stations. These plans are also to be made available to the Surveyor on board.

1.4.7 A functional description of the system configurations and intended systems operation in the event of a fire or flooding casualty for the services referred to in Sections 2 to 4. This is to include reversionary control stations and required internal communications. A copy is to be provided on board.

1.4.8 Identification and details:

(a) equipment designed to operate in flooded spaces or under fire conditions; and/or
(b) other flooding or fire protection measures.

1.4.9 A schedule of normal and emergency operating loads on the electrical system for the different expected operating conditions and services described in Sections 2 and 4.

1.4.10 Details identifying the auxiliary systems required for the operation and control of machinery and equipment to provide the services described in Sections 2 and 4.

1.4.11 Details of time period of operation and ship range and service speed corresponding to fuel storage capacity available in the event of fire or flooding scenarios.

1.4.12 A schedule of activities, including testing and trials, to verify that the ship is capable of providing the services described in Sections 2 and 4.

Section 2
Safe return to port

2.1 General

2.1.1 Consistent with the requirements of the relevant SOLAS Regulations, this Section provides design criteria for machinery and equipment described in 1.1.2 to remain operational for the ship's safe return to port under its own propulsion, in the event of:

(a) a fire casualty that does not exceed the casualty threshold; or

(b) flooding of any single watertight compartment;

2.1.2 When fire damage from a casualty does not exceed the casualty threshold or when the ship is subject to flooding of any single watertight compartment, machinery and equipment essential for the following services are to remain operational in the remaining part of the ship not affected by fire or flooding:

(a) **propulsion systems and their necessary auxiliaries and control systems**. Propulsion machinery and auxiliary machinery essential for the propulsion of the ship at a service speed and range/distance acceptable to the National Administration for return to port under its own propulsion, *see* Section 3;

(b) **steering systems and steering-control systems**. Steering systems and steering-control systems sufficient to provide manoeuvring capability acceptable to the National Administration for return to port under its own propulsion, *see* Section 3;

(c) **systems for transfer and service of oil fuel**. Systems for internal transfer and service of oil fuel capable of fuel supply to active propulsion and power generation equipment;

(d) **bilge and ballast system**. The bilge pumping systems, and all associated equipment essential for its operation, in all spaces not directly affected by the casualty, *see also* Chapter 13 and Pt 6, Ch 1,2.7;

(e) **flooding detection systems**. *See also* Ch 13,14;

(f) **internal communications**. The means of communication required by:

(i) Ch 1,4.7, Pt 6, Ch 1,2.2.2 and/or 2.6.4 between the bridge and machinery main and subsidiary control stations and engineer's accommodation; and

(ii) Ch 19,2.1.7 between the navigating bridge and the steering gear compartment;

necessary for operation of machinery and equipment, or otherwise identified by the National Administration to be required, during a ship's return to port under its own propulsion; and

(g) **navigation lights**. Electric circuit protection, controls and failure alarms for lights specified by the National Administration to be capable of operation, *see also* Pt 6, Ch 2,14.5.

2.1.3 In addition to the requirements of Pt 6, Ch 2,1.14 and 1.15, when fire damage from a casualty does not exceed the casualty threshold or when the ship is subject to flooding of any single watertight compartment, machinery and equipment essential for the following services are to remain operational in the remaining part of the ship not affected by fire or flooding:

(a) for **internal communication**:

(i) general emergency alarm system. This is in addition to the requirements of Pt 6, Ch 2,17.2;

(ii) public address system. This is in addition to the requirements of Pt 6, Ch 2,17.3; and

(iii) from the safety centre as required by Pt 6, Ch 2,16.10.3;

where identified by the National Administration to be required to satisfy the relevant SOLAS Regulations for communication between the bridge, engineering spaces, safety centre, fire-fighting and damage control teams, and for passenger and crew notification and mustering;

(b) for **fire main systems** where supplied by electrically driven fire pumps, the pumps (and electrical equipment essential for their operation) are to be located and arranged such that operating capability will be available in the event of any main vertical zones being directly affected by the casualty. This is in addition to the requirements of Pt 6, Ch 2,16.4;

(c) for **fixed fire-extinguishing systems**:

(i) for automatic sprinkler systems where supplied by electrically driven pumps, the pumps are to be located and arranged such that operating capability will be available in all spaces not directly affected by the casualty. This is in addition to the requirements of Pt 6, Ch 2,16.2;

(ii) for electrically driven refrigeration units for carbon dioxide fire-extinguishing systems, the units are to be located and arranged such that operating capability will be available in all spaces not directly affected by the casualty. This is in addition to the requirements of Pt 6, Ch 2,16.5; and

(iii) electrically operated fire-extinguishing media release alarms in spaces not directly affected by the casualty. This is in addition to the requirements of Pt 6, Ch 2,16.9.

(d) the fire detection and alarm system in all spaces not directly affected by the casualty. This is in addition to the requirements of Pt 6, Ch 1,2.8 and Pt 6, Ch 2,16.1;

(e) power-operated watertight doors in spaces not directly affected by the casualty. This is in addition to the requirements of Pt 6, Ch 2,18.1;

(f) lighting of safe areas and escape route or electrically powered low location lighting. This is in addition to the requirements of Pt 6, Ch 2, 3, 5.4, 5.7, 17.1 and 17.4; and

(g) other systems required by relevant engineering systems Rules that the National Administration has determined to be vital to damage control efforts.

2.1.4 When fire damage from a casualty does not exceed the casualty threshold or when the ship is subject to flooding of any single watertight compartment, electrical power, where required, is to be available and sustainable for the following services:

(a) those required by 2.1.2;

(b) navigational systems, including navigation lights, required by the National Administration to be capable of operation during return to port (*see also* Pt 7, Ch 9 for relevant classification notations);

(c) internal communication required during a ship's return to port under its own propulsion. Where applicable, charging power for portable means of communication is to be included;

(d) external communication (for communicating via the GMDSS or the VHF Marine and Air Band distress frequencies even if the main GMDSS equipment is lost);
(e) fire pumps for the fire main system not directly affected by the casualty;
(f) fixed fire-extinguishing systems (gaseous and water) designed to protect an entire space in all spaces not directly affected by the casualty;
(g) fire detection and alarm system in all spaces not directly affected by the casualty;
(h) power-operated watertight and semi-watertight doors;
(j) systems and equipment intended to support the provision of services to safe areas;
(k) other systems that the National Administration has determined to be vital to damage control efforts; and
(l) other fixed electrically powered loads intended to be operated during return to port.

The electrical power available is to be at least sufficient to supply the machinery and equipment specified by the National Administration as necessary and any additional loads identified in (l) during a ship's return to port under its own propulsion with due regard to such services as may be operated simultaneously.

2.1.5 Auxiliary and support systems (e.g. engine-room ventilation, lighting of spaces outside safe areas not affected by the casualty, etc.) required for the operation and control of machinery and equipment required to operate in accordance 2.1.2 and 2.1.3 and to provide electrical power in accordance with 2.1.4 are to remain operational.

2.1.6 Oil fuel stores, machinery and equipment are to have sufficient capacity to permit the services required by 2.1.2 to 2.1.5 to be provided for a time period of operation, ship range/distance and service speed acceptable to the National Administration for the ship's return to port under its own propulsion.

2.1.7 To satisfy 2.1.2 to 2.1.6, machinery and equipment is to be provided, constructed, segregated and arranged such that the services specified may be provided safely and effectively in the event of potential damage to machinery and equipment as a result of a fire that does not exceed the casualty threshold or flooding of any single watertight compartment, including control, safety, alarm and monitoring equipment and control stations.

2.1.8 A description of the intended system function in the event of fire or flooding for the services referred to in this Section are to be submitted for consideration, *see* 1.4.2 and 1.4.3. A risk based analysis is to be conducted in accordance with standards acceptable to LR to assess the availability of services required by this Section (for propulsion and steering, *see* Section 3; for other services, *see* 1.4.4 and 3.3.4).

■ *Section 3*
Qualitative failure analysis for propulsion and steering

3.1 General

3.1.1 A qualitative risk based failure analysis is to be conducted in accordance with this Section to assess compliance with the analysis objectives.

3.1.2 The analysis is to assess the magnitude and consequences of various types of potential hazards in the design that might lead to failure to fulfil the analysis objective(s) stated in 3.2. The following are to be considered during the analysis:
(a) analysis facilitation;
(b) these Rules;
(c) relevant statutory regulations and National Administration criteria;
(d) the ship design;
(e) the intended ship operation; and
(f) the relevant machinery, equipment and systems.

3.1.3 Those conducting the analysis and their roles are to be recorded in the analysis report.

3.1.4 Requirements specified by the National Administration to satisfy the relevant SOLAS Regulations for the ship's propulsion and steering during return to port (*see* 2.1.2) are to be identified in the analysis report, *see also* 1.3.1.

3.1.5 The analysis is to be documented, *see* 1.4.2, and two reports are to be submitted:
(a) a preliminary analysis, after the initial arrangements of different compartments and propulsion and steering arrangements are known, to permit an assessment of compliance with this Section. This is to include an assessment of propulsion and steering capability in the event of a failure, fire or flooding in any compartment casualty; and then
(b) a final report on the design, documenting compliance with this Section, that includes a detailed assessment of machinery and equipment required to provide propulsion and steering safely and effectively in accordance with the applicable requirements of 2.1.2.

3.1.6 Consideration will be given, on application, to review the extent that compliance with the requirements of this Section may be demonstrated by assignment of the following machinery class notations (described in Chapter 22):
(a) **PMR★** or **PMRL★** (Propulsion Machinery Redundancy in separate machinery spaces);
(b) **SMR★** or **SMRL★** (Steering Machinery Redundancy in separate machinery spaces); or
(c) **PSMR★** or **PSMRL★** (Propulsion and Steering Machinery Redundancy in separate machinery spaces).

3.2 Analysis objectives

3.2.1 For passenger ships having a length of 120 m or more, or having 3 or more main vertical zones, the analysis is to:

(a) assess, identify and record the effects of failure in propulsion and steering equipment and systems after a fire casualty or flooding as described in 2.1.1(a) and (b); and

(b) verify compliance with 2.1.2(a) and (b).

3.2.2 For other passenger ships, the analysis is to assess, identify and record the effects of failure in propulsion and steering equipment in any space.

3.3 Analysis scope

3.3.1 The analysis is to consider the propulsion and steering machinery, equipment and other associated systems and equipment which might impair the availability of propulsion and steering.

3.3.2 To consider the effects of fire or flooding, the analysis is to address the installed locations of relevant equipment and systems.

3.3.3 The analysis is to include assessment of potential common cause failures and consequential failures when analysing system redundancy intended to maintain propulsion and/or steering in the event of a failure.

3.3.4 Where the analysis scope is extended to additionally consider other services and verify additional compliance with the requirements of Sections 2 and/or 4, details may be submitted, *see* 1.4.3 and 1.4.4.

■ *Section 4*
Orderly evacuation and abandonment after a casualty

4.1 General

4.1.1 Consistent with the requirements of the relevant SOLAS Regulations, this Section provides design criteria for machinery and equipment described in 1.1.2 to remain operational, thereby supporting orderly evacuation and abandonment of the ship in the event of a fire that exceeds the casualty threshold.

4.1.2 In addition to the requirements of Pt 6, Ch 2,1.14, when fire damage from a casualty exceeds the casualty threshold, machinery and equipment essential for the provision of the following emergency services are to remain operational in the remaining part of the ship not affected by fire:

(a) for **fire main systems** where supplied by electrically driven fire pumps, the pumps (and electrical equipment essential for their operation) are to be located and arranged such that operating capability will be available in all main vertical zones not directly affected by the casualty. This is in addition to the requirements of Pt 6, Ch 2,16.4;

(b) for **internal communication**:
  (i) general emergency alarm system. This is in addition to the requirements of Pt 6, Ch 2,17.2;
  (ii) public address system. This is in addition to the requirements of Pt 6, Ch 2,17.3; and
  (iii) from the safety centre as required by Pt 6, Ch 2,16.10.3;

  where identified by the National Administration to be required to satisfy SOLAS 1974 as amended, Chapter II-2/G, Regulation 22.3.1.2 for communication in support of fire-fighting and/or for passenger and crew notification and evacuation;

(c) for **bilge systems**, the bilge pumping systems, and all associated equipment essential for its operation, in all spaces not directly affected by the casualty to permit the removal of fire-fighting water. This is in addition to the requirements of Chapter 13 and Pt 6, Ch 1,2.7; and

(d) lighting of escape routes, assembly stations and at embarkation stations of life-saving appliances and electrically powered low location lighting. This is in addition to the requirements of Pt 6, Ch 2, 3, 5.4, 5.7, 17.1 and 17.4.

4.1.3 When fire damage from a casualty exceeds the casualty threshold, electrical power, where required, is to be available and sustainable for the following services:

(a) those required by 4.1.2;

(b) other required means of internal communications systems not addressed by 4.1.2(b);

(c) means of external communications provided to communicate via the GMDSS or the VHF Marine and Air Band distress frequencies even if the main GMDSS equipment is lost;

(d) guidance systems for evacuation not addressed by 4.1.2(d);

(e) life-saving appliances and arrangements;

(f) other systems that the National Administration has determined to be necessary to comply with SOLAS 1974 as amended, Chapter II-2/G, Regulation 22.3.1; and

(g) other fixed electrically powered loads intended to be operated during evacuation and abandonment.

The electrical power available is to be at least sufficient to supply the machinery and equipment specified by the National Administration as necessary to support orderly evacuation and abandonment with due regard to such services as may be operated simultaneously.

4.1.4 Machinery and equipment required to satisfy this sub-Section is to be capable of operation for at least 3 hours based on the assumption of no damage outside the unserviceable main vertical zone. System operation within the unserviceable main vertical zones is not required.

4.1.5 A description of the intended system function in the event of fire for the services referred to in this Section is to be submitted for consideration, *see* 1.4.3. A risk based analysis is to be conducted in accordance with standards acceptable to LR to assess the availability of services required by this Section, *see* 1.4.4 and 3.3.4.

■ *Section 5*
Verification, testing and trials

5.1 General

5.1.1 Activities, including testing and trials, are to be carried out to verify that the services described in Sections 2 and 4 may be provided in the event of fire or flooding to the satisfaction of LR, *see* 1.4.12.

5.1.2 Testing and trials, as identified in the risk based analyses, are to be carried out to verify the findings and demonstrate that the intended system operation addresses the hazards identified.

5.2 Trials

5.2.1 In addition to the requirements for sea trials in Ch 1,5.2, trials are to be carried out to demonstrate that an acceptable service speed and steering capability for return to port can be achieved in the event of fire or flooding, *see* 2.1.2(a) and (b). The operational envelope(s) under the failure conditions is(are) to be determined.

Part 6, Chapter 1
Control Engineering Systems

Effective date 1 July 2010

■ *Section 1*
General requirements

1.1 General

1.1.7 Control engineering systems on passenger ships having a length of 120 m or more or having three or more main vertical zones (*see* Pt 5, Ch 23,1.2.4 for definitions) are, in addition to the requirements of this Chapter, to be located, designed and arranged to comply with Pt 5, Ch 23, as applicable.

~~*1.1.7*~~ *1.1.8* Section 6 of this Chapter states requirements which shall apply where it is intended that the control and supervision of ship operational functions are computer based. In general ships complying with the requirements of Section 6 will be eligible for the class notation **ICC**, *see* Pt 1, Ch 2,2.

~~*1.1.8*~~ *1.1.9* LR will be prepared to give consideration to special cases or to arrangements which are equivalent to the Rules. For unconventional designs, *see also* Pt 7, Ch 16.

1.2 Plans

1.2.5 **Programmable electronic systems**. In addition to the documentation required by 1.2.2 the following is to be submitted:

- System requirements specification.
- System integration plan, *see* 2.13.2.
- Failure Mode and Effects Analysis (FMEA), *see* 2.13.5
- Details of the hardware configuration in the form of a system block diagram, including input/output schedules.
- Hardware certification details, *see* 2.10.5 and 2.12.3.
- Software quality plans, including applicable procedures, *see* ~~2.10.21~~ 2.10.25.
- Factory acceptance, integration and sea trial test schedules for hardware and software.
- Details of data storage arrangements, *see* 2.10.10 and 2.12.6.

■ *Section 2*
Essential features for control, alarm and safety systems

2.10 Programmable electronic systems – General requirements

2.10.6 Emergency stops are to be hard-wired and independent of any programmable electronic equipment. Alternatively, the system providing emergency stop functions is to comply with the requirements of 2.12.2 and/or ~~2.12.8~~ 2.12.9.

2.10.8 Means are to be provided to recover or replace data required for safe and effective system operation lost as a result of component failure. The submission required by 1.2.5 is to address reinstatement of system operation following data loss.

~~*2.10.8*~~ *2.10.9* System configuration, programs and data are to be protected against loss or corruption in the event of failure of any power supply. For essential services and safety critical systems, *see* 2.12.6.

2.10.10 Where it is necessary to store data required for system operation in volatile memory, a back-up power supply is to be provided that prevents data loss in the event of loss of the normal power supply. The submission required by 1.2.5 is to include details of any routine maintenance necessary and the measures necessary to restore system operation in the event of data loss as a result of power supply failure.

2.10.11 Back-up power supplies required by 2.10.10 are to be rated to supply the connected load for a defined period of time that allows sufficient time to restore the supply in the event of loss of the normal power supply as a result of failure of a main source of electrical power. This period is not to be less than 30 minutes.

2.10.12 Where regular battery replacement is required to maintain the availability of volatile memory back-up power supply required by 2.10.10, these are to be included in the schedule of batteries required by Ch 2,1.2.11 and 11.7, irrespective of battery type and size. Applicable entries in this schedule are to note that these batteries are not for safety critical systems or essential or emergency services.

Existing paragraphs 2.10.9 *to* 2.10 21 *have been renumbered* 2.10 13 *to* 2.10.25.

2.12 Programmable electronic systems – Additional requirements for essential services and safety critical systems

2.12.6 Volatile memory is not to be used to store data required for:

- an essential service or safety critical functions; or
- ensuring safety or preventing damage, including during start-up or re-start.

Alternative proposals which demonstrates that an equivalent level of system integrity will be achieved may be submitted for consideration.

Existing paragraphs 2.12.6 *to* 2.12.9 *have been renumbered* 2.12 7 *to* 2.12.10.

■ *Section 3*
Control and supervision of unattended machinery

3.2 Oil engines for propulsion purposes

Table 1.3.1(a) Oil engines for propulsion purposes: Alarms and slowdowns (*conclusion*) (*Part only shown*)

Item	Alarm	Note
Feed water or water/thermal fluid forced circulation flow (if fitted)	Low	*See* Pt 5, Ch 14,6.2.7 and Note 7
Uptake temperature	High	To monitor for soot fires. *See* Notes 7 and 8

NOTES
6. May be combined with exhaust gas outlet temperature high alarm where the turbocharger is mounted directly on the exhaust manifold.
7. Alarm only required when an exhaust gas economiser/boiler/ thermal oil heater is fitted.
8. Alternatively, details of an appropriate fire detection system are to be submitted for consideration.

3.4 Gas turbine machinery

Table 1.3.3 Gas turbine machinery: Alarms and safeguards (*Part only shown*)

Item	Alarm	Note
Air intake pressure	Low	*See also* Pt 5, Ch 4,4.4.4
Feed water or water/thermal fluid forced circulation flow (if fitted)	Low	*See* Pt 5, Ch 14,6.2.7 and Note 4
Uptake temperature	High	To monitor for soot fires. *See* Notes 4 and 5

NOTES
1. For two-stage alarms, *see also* 3.1.4.
2. For requirements on purging before ignition, *see* Pt 5, Ch 4,6.2.1.
3. Where a requirement for disabling the automatic protection and safety system devices for machinery and engineering systems has been defined by the Owner, the consequences of using the disabling arrangements are to be established and included in the operations procedures and orders provided onboard ship. Details of any disabling arrangements are to be submitted to LR for consideration in each instance.
4. Alarm only required when suitable for operation on residual fuel grades and an exhaust gas economiser/boiler/thermal oil heater is fitted.
5. Alternatively, details of an appropriate fire detection system are to be submitted for consideration.

3.5 Main, auxiliary and other boilers

Table 1.3.4 Main, auxiliary and other boilers: Alarms and safeguards (*see continuation*) (*Part only shown*)

Item	Alarm	Note
Feed water or water forced circulation flow (if fitted)	Low	Oil fuel to burners to be shut-off automatically, *see* ~~Note 5~~ Notes 5 and 6
Uptake temperature	High	Where economiser and/or gas air heaters are integral with the boiler and also for independent ~~extended surface~~ exhaust gas boilers/economisers, to monitor for soot fires. *See* Note 7

NOTES
6. For exhaust gas economisers/boilers requiring feed water or forced water circulation, the low flow alarm is to be fitted with provision to over-ride the alarm if the exhaust gas economiser/boiler is to be operated in the dry condition. *See also* Pt 5, Ch 14,6.2.5.
7. Alternatively, details of an appropriate fire detection system are to be submitted for consideration.

3.6 Thermal fluid heaters

Table 1.3.5 Thermal fluid heaters: Alarms and safeguards (*Part only shown*)

Item	Alarm	Note
Thermal fluid flow	Low	Oil fuel burners to be shut-off automatically, *see* Note 5
Uptake temperature	High	~~Where applicable, to~~ To monitor for soot fires Oil fuel to the burner is to be shut-off, *see* Notes 4 and 6

NOTES

4. Alarm and oil fuel shut-off only required where exhaust gas economisers/boilers are fitted.
5. For exhaust gas economisers/boilers requiring thermal fluid forced circulation, the low flow alarm is to be fitted with provision to over-ride the alarm if the exhaust gas economiser/boiler is to be operated in the dry condition. *See also* Pt 5, Ch 14,6.2.5.
6. Alternatively, details of an appropriate fire detection system are to be submitted for consideration.

3.7 Inert gas generators

Table 1.3.6 Inert gas generators: Alarms and safeguards (*Part only shown*)

Item	Alarm	Note
Cooling water temperature	High	—
Combustion space cooling water level (where continuous circulation is required)	High	Cooling water pump and oil fuel to burner are to be shut-off automatically
Oil fuel supply	Insufficient	

3.9 Auxiliary engines and auxiliary steam turbines

Table 1.3.8 Auxiliary engines and auxiliary steam turbines: Alarms and safeguards (*Part only shown*)

Item	Alarm	Note
OIL ENGINES		
Exhaust gas temperature (for engines >500 kW/cylinder)	High	Per cylinder. For engine power <500 kW/cylinder, common sensors for each inlet to the turbo-charger may be accepted
Feed water or water/thermal fluid forced circulation flow (if fitted)	Low	*See* Pt 5, Ch 14,6.2.7 and Note 3
Uptake temperature	High	To monitor for soot fires. *See* Notes 3 and 4

NOTES

3. Alarm only required when an exhaust gas economiser/boiler/ thermal oil heater is fitted.
4. Alternatively, details of an appropriate fire detection system are to be submitted for consideration.

■ *Section 7* Trials

7.1 General

7.1.3 Acceptance tests and trials for programmable electronic systems are to include verification of software lifecycle activities appropriate to the stage in the system's lifecycle at the time of system examination. The documentation required by 1.2.5 is to be in accordance with the current configuration and the testing and trials are to address software modifications and configuration management procedures to the Surveyor's satisfaction.

Part 6, Chapter 2
Electrical Engineering

Effective date 1 July 2010

■ *Section 1*
General requirements

1.1 General

1.1.6 Electrical installations on passenger ships having a length of 120 m or more or having three or more main vertical zones (*see* Pt 5, Ch 23,1.2.4 for definitions) are, in addition to the requirements of this Chapter, to be located, designed and arranged to comply with Pt 5, Ch 23, as applicable.

~~*1.1.6*~~ *1.1.7* Lloyd's Register (hereinafter referred to as 'LR') will be prepared to give consideration to special cases or to arrangements which are equivalent to the Rules. For unconventional designs, *see also* Pt 7, Ch 16. Consideration will also be given to electrical arrangements of small ships and ships to be assigned class notation for restricted or special services.

1.2 Plans

1.2.5 For ships in which explosive gas atmospheres and/or combustible dusts occur, – a general arrangement of the ship showing hazardous zones and spaces, as defined within Section 13, is to be submitted. Where the explosive gas or combustible dust is not associated with the ship's cargo, arrangement drawings for the hazardous locations only may be submitted in place of the complete ship general arrangement.

1.2.6 A schedule of electrical equipment ~~located in hazardous areas~~ for use in explosive gas atmospheres or in the presence of combustible dusts giving details, as appropriate, of:

(a) type of equipment;
(b) type of protection, e.g. Ex 'd';
(c) apparatus group, e.g. IIB;
(d) temperature class, e.g. T3;
(e) enclosure ingress protection, e.g. IP55;
(f) certifying authority;
(g) certificate number;
(h) location of equipment.

Details may be included on arrangement drawings for the hazardous locations, in place of a separate schedule. Where uncertified equipment is permitted by 13.2 or 13.3 or the Rules relevant to the specific type of ship, details of other documentation confirming (b) to (d) may be submitted in place of those listed under (f) and (g).

1.2.8 Details of electrically-operated fire, ship, crew and passenger emergency safety systems which are to include typical single line diagrams and arrangements, showing main vertical and, where applicable, horizontal fire zones, spaces along the ship bottom that are not fitted with a double bottom and the location of equipment and cable routes, including identification of relevant high fire risk ~~fire~~ areas, to be employed for:

(a) emergency lighting;
(b) accommodation fire detection, alarm and extinction systems;
(c) fixed water-based local application fire-fighting systems;
(d) public address system;
(e) general alarm;
(f) watertight doors, bow, stern and shell doors and other electrically operated closing appliances; and
(g) low location lighting.

~~NOTE~~

A general arrangement plan of the complete ship showing the main vertical fire zones, spaces along the ship bottom that are not fitted with a double bottom and the location of equipment and cable routes, including identification of relevant high fire risk ~~fire~~ areas, for the above systems, is to be made available for the use of the Surveyor on board.

1.2.19 For non-metallic cable support systems or protective casings, test evidence, details of installation procedures and manufacturer's recommendations that show compliance with 10.13.

1.3 Surveys

1.3.3 For electric propulsion systems, in addition to the equipment listed in 1.3.2, the following equipment is to be surveyed by the Surveyors during manufacture and testing:

- exciters;
- filters;
- reactors;
- dynamic braking assemblies; ~~and~~
- pre-magnetisation transformers; and
- slip ring assemblies.

1.4 Additions or alterations

1.4.4 Proposed modifications to the electrical protection settings are to be developed in accordance with 6.1.4 and plans submitted are also to address the updating of approved version of the details required by 1.2.3 and 1.2.4.

Existing paragraph 1.4.4 *has been renumbered* 1.4.5.

1.5 Definitions

1.5.13 Protected areas are areas within a protected space which ~~is required to be~~ are protected by a fixed water-based local application fire-fighting system.

1.5.15 For emergency services and their emergency power supplies required to be capable of being operated under fire conditions, 'high fire risk areas' are:

(a) machinery spaces, as defined by SOLAS 1974 as amended, Ch II-2;
(b) spaces containing fuel treatment equipment;
(c) galleys and pantries containing cooking appliances;
(d) laundries containing drying equipment;
(e) hazardous zones and spaces; and
(f) for passenger ships carrying more than 36 passengers:
  (i) public spaces containing furniture and furnishings of other than restricted fire risk and having a deck area of 50 m^2 or more;
  (ii) barber shops and beauty parlours; and
  (iii) saunas;

Requests to exempt spaces identified in (f) may be considered when evidence is submitted that demonstrates emergency services will remain available in the event of a fire in the space (e.g. studies of fire protection measures, installation locations, system redundancy, etc.).

1.11 Earthing of non-current carrying parts

1.11.3 Where extraneous-conductive parts (i.e. parts not forming part of the electrical installation and liable to introduce an electric potential) are not bonded by separate earthing conductors, details are to be submitted that demonstrate that a permanent, metal-to-metal connection of negligible impedance, which will not degrade due to corrosion or vibration, will be achieved.

~~*1.11.3*~~ *1.11.4* Armouring, braiding and other metal coverings of cables are to be effectively earthed. Where the armouring, braiding and other metal coverings are earthed at one end only, they are to be adequately protected and insulated at the unearthed end with the insulation being suitable for the maximum voltage that may be induced. *See* ~~13.8.3~~ 13.9.4 for earthing of cables in ~~dangerous~~ hazardous zones or spaces.

Existing paragraphs 1.11.4 *to* 1.11.10 *have been renumbered* 1.11.5 *to* 1.11.11.

1.15 Operation under flooding conditions

1.15.1 Flooding of spaces along the ship bottom that are not fitted with a double bottom is not to result in the loss of the ability to provide electrically operated fire, ship, crew and passenger emergency safety systems outside of the spaces.

1.15.2 Installation of electrical equipment necessary to provide fire, ship, crew and passenger emergency safety systems in spaces along the ship bottom not fitted with a double bottom is to be avoided, wherever practical. Where it is proposed to install electrical equipment, including cabling, necessary to provide fire, ship, crew and passenger emergency safety systems in such spaces, evidence is to be submitted to demonstrate that required emergency services will be available in other spaces in the event of flooding of the space not fitted with a double bottom.

Existing sub-Section 1.15 *has been renumbered* 1.16.

~~1.15~~ 1.16 Protection of electrical equipment against the effects of lightning strikes

1.17 Programmable electronic systems

1.17.1 Where programmable electronic systems are implemented and used to control the electrical installation, or to provide safety functions in accordance with the requirements of this Chapter (e.g. electric propulsion, circuit-breaker settings, switchgear and control gear controllers, etc.), the arrangements are to satisfy the applicable requirements of Ch 1,2.10 to 2.13.

1.17.2 Where 1.16.1 applies, proposed modifications to software and acceptance testing and trials are to be in accordance with Ch 1,1.4 and Section 7 as applicable.

■ *Section 3*
Emergency source of electrical power

3.2 Emergency source of electrical power in passenger ships

(*Part only shown*)

3.2.7 The electrical power available is to be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously. The emergency source of electrical power is to be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:

(a) For a period of 36 hours, emergency lighting:
  (i) at every ~~lifeboat~~ survival craft preparation station, muster and embarkation station and oversides;
(h) Where connected, the supplementary lighting required by 3.2.16 and, where applicable, the air compressors for breathing apparatus cylinders referred to in 16.11.1.

3.2.9 The transitional source of emergency electrical power required by 3.2.8 is to consist of an accumulator battery suitably located for use in an emergency which is to operate without recharging while maintaining the voltage of the battery throughout the discharge period within 12 per cent above or below its nominal voltage and be of sufficient capacity and so arranged as to supply automatically in the event of failure of either the main or emergency source of electrical power for half an hour at least the following services, if they depend upon an electrical source for their operation:

(a) ~~For half an hour:~~
   ~~(i)~~ the lighting required by 3.2.7(a) and (b);

(b) ~~(ii)~~ all services required by 3.2.7(c)(i), (iii) and (iv) unless such services have an independent supply for the period specified from an accumulator battery suitably located for use in an emergency.

(c) ~~(iii)~~ Where connected, the supplementary lighting required by 3.2.16.

(d) ~~(b)~~ Power to operate the watertight doors at least three times, i.e. closed-open-closed against an adverse list of 15°, but not necessarily all of them simultaneously, together with their control, indication and alarm circuits as required by 3.2.7(f)(i).

3.3 Emergency source of electrical power in cargo ships

(*Part only shown*)

3.3.7 The electrical power available is to be sufficient to supply all those services that are essential for safety in an emergency, due regard being paid to such services as may have to be operated simultaneously. The emergency source of electrical power is to be capable, having regard to starting currents and the transitory nature of certain loads, of supplying simultaneously at least the following services for the periods specified hereinafter, if they depend upon an electrical source for their operation:

(a) For a period of three hours, emergency lighting at every ~~lifeboat~~ survival craft preparation station, muster and embarkation station and over the sides. Remotely located stations for a liferaft installed in accordance with SOLAS 1974 as amended, Ch III/B, Regulation 31.1.4 that is provided with portable means of illumination acceptable to the National Administration with which the Ship is registered may be considered to satisfy this requirement;

■ *Section 5*
Supply and distribution

5.1 Systems of supply and distribution

(*Part only shown*)

5.1.2 For tankers intended for the carriage in bulk of oil, liquefied gases and other hazardous liquids having a flash point not exceeding 60°C (closed-cup test) only the following systems of generation and distribution are acceptable:

(d) earthed systems, a.c. or d.c., limited to areas outside any ~~dangerous~~ hazardous space or zone, and arranged so that no current arising from an earth-fault in any part of the system could pass through a ~~dangerous~~ hazardous space or zone;

Earthed intrinsically-safe circuits are permitted to pass into and through ~~dangerous~~ hazardous spaces and zones.

■ *Section 6*
System design – Protection

6.1 General

6.1.4 Protection systems are to be developed using a systematic design procedure incorporating verification and validation methods to ensure successful implementation of the requirements above. Details of the procedures used are to be submitted when requested. An approved copy of the details required by 1.2.3 and 1.2.4 is to be retained on board and made available to the Surveyor on request.

■ *Section 7*
Switchgear and control gear assemblies

7.3 Circuit-breakers

7.3.5 Where the means of setting adjustable protection characteristics are not durably marked and locked in position and cannot be visually inspected (e.g. electronic storage), the settings of characteristics are to be recorded and a copy of the records included in the details retained on board, *see* 6.1.4.

7.11 Instruments for alternating current generators

7.11.4 The indicators and displays required by 7.11.1 to 7.11.3 are to be located and arranged such that they may be viewed at a single operating position. Where manual paralleling is provided, it is to be possible to adjust voltage and frequency at this position.

Existing paragraph 7.11.4 *has been renumbered* 7.11.5.

■ *Section 9*
Converter equipment

9.1 Transformers

9.1.12 The following tests are to be carried out on all transformers at the manufacturer's works, and a certificate of tests issued by the manufacturer, *see also* 1.3.2 and 1.3.3:

(a) measurement of winding resistances, voltage ratio, impedance voltage, short-circuit impedance, insulation resistance, load loss, no load loss and current;

(b) dielectric tests;

(c) temperature rise test on one transformer of each size and type~~.~~; and

(d) where evidence of compliance with 9.1.9 is not submitted for consideration, short-circuit withstand on one transformer of each size and type.

Section 10
Electric cables and busbar trunking systems (busways)

10.8 Installation of electric cables

10.8.4 Electric cables for essential and emergency services are to be arranged, so far as is practicable, to avoid galleys, machinery spaces and other enclosed spaces and ~~areas of~~ high fire risk areas except as is necessary for the service being supplied. Such cables are also, so far as reasonably practicable, to be routed clear of bulkheads to preclude their being rendered unserviceable by heating of the bulkheads that may be caused by a fire in an adjacent space.

10.8.7 Cables having ~~a bare~~ an exposed metallic screen, braid or armour are to be installed in such a manner that galvanic corrosion by contact with other metals is prevented. Sufficient measures are also to be taken to prevent damage to ~~any bare~~ exposed galvanised coatings during installation.

10.8.8 ~~Consideration is to be given to providing adequate protection~~ Protection is to be provided for cable oversheaths in areas where cables are likely to be exposed to damaging substances under normal circumstances or areas where the spillage or release of harmful substances is likely.

10.9 Mechanical protection of cables

~~*10.9.3* Non-metallic protective casings and fixings are to be flame retardant in accordance with the requirements of IEC 60092-101.~~

~~*10.9.4*~~ *10.9.3* Metal protective casings are to be efficiently protected against corrosion, and effectively earthed in accordance with 1.11.

10.10 Cable support systems

10.10.2 Cable support systems, which may be in the form of trays or plates, separate support brackets, hangers or ladder racks, together with their fixings and accessories, are to be robust and are to be of corrosion-resistant material or suitably corrosion inhibited before erection. ~~Where cable support systems are manufactured of plastics materials, evidence of satisfactory type testing in accordance with an acceptable test procedure is to be submitted for consideration.~~ The cable support system is to be effectively secured to the ship's structure, the spacing of the fixings taking account of the probability of vibration and any heavy external forces, e.g. where located in areas subject to impact by sea-water.

~~*10.10.5* Where the cable support system or fixings are manufactured from a material other than metal, suitable supplementary metallic fixings or straps spaced at regular distances are to be provided, such that, in the event of a fire or failure, the cable support system and the cables affixed to it are prevented from falling and causing an injury to personnel and/or an obstruction to any escape route. Alternatively, the cables may be routed away from such areas.~~

~~*10.10.6* Cable support systems manufactured of plastics materials installed on the open deck are to be protected from degradation caused by exposure to solar radiation.~~

~~*10.10.7*~~ *10.10.5* Single core electric cables are to be firmly fixed, using supports of strength adequate to withstand forces corresponding to the values of the peak prospective short-circuit current.

10.11 Penetration of bulkheads and decks by cables

10.11.1 Where electric cables pass through watertight, fire insulated or gastight bulkheads or decks separating ~~dangerous~~ hazardous zones or spaces from ~~non-dangerous~~ non-hazardous zones or spaces, the arrangements are to be such as to ensure the integrity of the bulkhead or deck is not impaired. The arrangements chosen are to ensure that the cables are not adversely affected.

10.12 Installation of electric cables in protective casings

~~*10.12.2* When protective casings are secured by means of clips or straps manufactured from a material other than metal the fixings are to be supplemented by suitable metal clips or straps spaced at regular distances each not exceeding 2 m.~~

Existing paragraphs 10.12.3 *to* 10.12.8 *have been renumbered* 10.12.2 *to* 10.12.7.

10.13 Non-metallic cable support systems, protective casings and fixings

10.13.1 Where it is proposed to use non-metallic cable support systems, protective casings or fixings, the additional requirements of this sub-Section apply. For high voltage installations, metallic protective casings are required where 10.8.12(b) applies.

10.13.2 Non-metallic cable support systems and protective casings are to be installed in accordance with the manufacturer's recommendations. The support systems and protective casings are to have been tested in accordance with an acceptable test procedure for:

(a) ambient operating temperatures;
(b) safe working load;
(c) impact resistance;
(d) flame retardancy;
(e) smoke and toxicity; and
(f) use in explosive gas atmospheres or in the presence of combustible dusts, electrical conductivity;

with satisfactory results.

10.13.3 Non-metallic cable support systems, protective casings and fixings installed on the open deck are to be protected from degradation caused by exposure to solar radiation.

10.13.4 Where the cable support system, protective casing or fixings are manufactured from a material other than metal, suitable supplementary metallic fixings or straps spaced at regular distances are to be provided such that, in the event of a fire or failure, the cable support system, protective casing and the affixed cables are prevented from falling and causing an injury to personnel and/or an obstruction to any escape route. Alternatively, the cables may be routed away from such areas.

10.13.5 The load on non-metallic cable support systems or protective casings is not to exceed the tested safe working load.

10.13.6 When a cable support system or protective casing is secured by means of clips or straps manufactured from a material other than metal the fixings are to be supplemented by suitable metal clips or straps spaced at regular distances each not exceeding 2 m and, for non-metallic cable support systems or protective casings, that used during safe working load testing.

10.13.7 Non-metallic fixings are to be flame retardant in accordance with the requirements of IEC 60092-101, or an alternative, relevant National or International Standard.

~~10.13~~ 10.14 Single-core electric cables for alternating current

Existing paragraphs 10.13.1 *to* 10.13.6 *have been renumbered* 10.14.1 *to* 10.14.6.

~~10.14~~ 10.15 Electric cable ends

Existing paragraphs 10.14.1 *to* 10.14.7 *have been renumbered* 10.15.1 *to* 10.15.7.

~~10.15~~ 10.16 Joints and branch circuits in cable systems

Existing paragraphs 10.15.1 *to* 10.15.3 *have been renumbered* 10.16.1 *to* 10.16.3.

~~10.16~~ 10.17 Busbar trunking systems (bustrunks)

Existing paragraphs 10.16.1 *to* 10.16.6 *have been renumbered* 10.17.1 *to* 10.17.6.

■ *Section 11*
Batteries

11.3 Location

11.3.10 Only electrical equipment necessary for operational reasons and for the provision of lighting is to be installed in compartments provided in compliance with 11.3.1, the compartment ventilation exhaust ducts and zones within a 1,5 m radius of the ventilation outlet(s). Such electrical equipment is to be certified for group IIC gases and temperature Class T1 in accordance with IEC 60079: *Electrical apparatus for explosive gas atmospheres*, or an acceptable and relevant National Standard.

■ *Section 13*
Electrical equipment for use in explosive gas atmospheres or in the presence of combustible dusts

13.1 General

13.1.3 Equipment that is to be installed in an area where both explosive gases and combustible dusts can be present is to be selected in accordance with both 13.2 and 13.3.

13.1.4 For permanent secondary battery installations, *see* Section 11.

13.1.5 Details of installations in paint stores that satisfy the requirements of alternative and relevant standards acceptable to LR may be submitted for consideration.

13.2 Selection of equipment for use in explosive gas atmospheres

~~*13.2.1* When apparatus is to be installed in areas where an explosive gas atmosphere may be present, unless permitted otherwise by 13.2.2, it is to be of a 'safe type', as listed below, certified or approved by a competent authority for the gases encountered. The construction and type testing is to be in accordance with IEC 60079: *Electrical Equipment for Explosive Gas Atmospheres* or an acceptable and relevant National Standard.~~

~~Intrinsically safe~~	~~–~~	~~Ex 'i'~~
~~Increased safety~~	~~–~~	~~Ex 'e'~~
~~Flameproof~~	~~–~~	~~Ex 'd'~~
~~Pressurised enclosure~~	~~–~~	~~Ex 'p'~~
~~Powder filled~~	~~–~~	~~Ex 'q'~~
~~Encapsulated~~	~~–~~	~~Ex 'm'~~

~~*13.2.2* Consideration may be given to the use of equipment of the following types:~~

~~(a) equipment such as control panels, protected by purging and pressurisation and capable of being verified by inspection as meeting the requirements of IEC 60079-2;~~

~~(b) simple non-energy-storing apparatus having negligible surface temperature rise in normal operation, such as limit switches, strain gauges, etc, incorporated in intrinsically-safe circuits;~~

~~(c) radio aerials having robust construction, meeting the relevant requirements of IEC 60079-15. Additionally, in the case of transmitter aerials, it is to be shown, by detailed study or measurement, or by limiting the peak radiated power and field strength to 1 W and 30 V/m, respectively, that they present negligible risk of inducing incendive sparking in adjacent structures or equipment;~~

~~(d) electrical apparatus with type of protection 'n' or 'N' provided it is in a well ventilated area on open deck and not within 3 m of any flammable gas or vapour outlet.~~

~~(e) electrical apparatus selected in accordance with IEC 60092-502: *Electrical Installations in Ships – Tankers – Special Features*, *see* 13.9 to 13.11.~~

~~*13.2.3* Where apparatus is to be installed in areas where combustible dusts may be present in quantities sufficient to create an explosive atmosphere, it is, when practicable, to be of a type certified or approved by a competent authority for the dusts and additionally any explosive gases encountered.~~

13.2.1 When equipment is to be installed in areas where an explosive gas atmosphere may be present it is generally to be of a type providing protection against ignition of the gases encountered and compliant with the relevant Parts of IEC 60079, *(Electrical Apparatus for) Explosive Gas Atmospheres*, or an acceptable and relevant National Standard, unless permitted otherwise by 13.2.4, 13.2.5 or 13.2.6.

13.2.2 The equipment protection type permitted depends on the hazardous zone where the equipment is to be located, as defined in 13.5. For certain locations on the ship other requirements may limit installations to specific equipment types and/or particular applications.

13.2.3 Equipment for **zone 0** or **zone 1**, with the exception of simple apparatus as defined in 13.2.4 or 13.2.5, is to be certified or approved by a National or other appropriate authority. Equipment without independent certification or approval may be considered for installation in **zone 2**.

13.2.4 In **zone 0**, the following may be considered:

(a) intrinsically safe, category 'a' (Ex 'ia'); or

(b) simple electrical apparatus and components (for example thermocouples, photocells, strain gauges, junction boxes, switching devices), included in intrinsically-safe circuits of category 'ia', not capable of storing or generating electrical power or energy in excess of the limits given in IEC 60079-14, *Explosive atmospheres Part 14: Electrical installations design, selection and erection*.

13.2.5 In **zone 1**, the following may be considered:

(a) apparatus permitted within **zone 0**;

(b) intrinsically safe, category 'b' (Ex 'ib');

(c) simple apparatus as defined above, included in intrinsically-safe circuits of category 'ib';

(d) increased safety (Ex 'e');

(e) flameproof (Ex 'd');

(f) pressurised enclosure (Ex 'p');

(g) powder filled (Ex 'q'); or

(h) encapsulated (Ex 'm').

13.2.6 In **zone 2**, the following may be considered:

(a) apparatus permitted within **zone 0** or **zone 1**;

(b) type of protection 'n' or 'N';

(c) equipment such as control panels, protected by purging and pressurisation and capable of being verified by inspection as meeting the requirements of IEC 60079-2; or

(d) radio aerials having robust construction, meeting the relevant requirements of IEC 60079-15. Additionally, in the case of transmitter aerials, it is to be shown, by detailed study or measurement, or by limiting the peak radiated power and field strength to 1 W and 30 V/m, respectively, that they present negligible risk of inducing incendive sparking in adjacent structures or equipment.

13.2.7 Apparatus having type of protection 'ia', 'ib', or 'd', is to be of a Group (IIA, IIB or IIC) meeting or exceeding that required for safe operation in the presence of any gas or vapour that can be present, or is to be certified specifically for such gases or vapours.

13.2.8 All apparatus is to be of a temperature classification (T1 to T6) that confirms, or is to be assessed so as to confirm, that its maximum surface temperature will not reach the ignition temperature of any gas or vapour, or mixture of gases or vapours, which can be present. The surface temperature considered may be that of an internal or external part, according to the type of protection of the apparatus.

13.2.9 Consideration may also be given to other types of protection, selected in accordance with the requirements of IEC 60079-14 or arrangements complying with IEC 60092-502, *Electrical Installations in Ships – Tankers – Special Features*, *see also* 13.10 to 13.12.

13.3 Selection of equipment for use in the presence of combustible dusts

13.3.1 Where apparatus is to be installed in **hazardous areas**, as defined by 13.5.3, associated with the presence of combustible dusts, it is, when practicable, to be of a type certified or approved by a National or other appropriate authority for the dusts and, additionally, any explosive gases encountered.

~~*13.2.4*~~ *13.3.2* Electrical equipment for use in ~~combustible dust atmospheres~~ such **hazardous areas** is to be so designed and installed as to minimise the accumulation of dust which may interfere with the safe dissipation of heat from the enclosure.

13.3.3 Where apparatus is to be installed in **extended hazardous areas**, as defined by 13.5.3, associated with the presence of combustible dust, the following may be considered:

(a) apparatus permitted within a hazardous area associated with the combustible dust(s) that can be present;
(b) apparatus having degree of protection IP5X, or better, and having a surface temperature under normal operating conditions not exceeding the auto-ignition temperature of the dust(s) that can be present; and
(c) apparatus of a type which ensures absence of sparks or arcs and hot spots during normal operation.

~~*13.2.5*~~ *13.3.4* Where equipment certified for combustible dusts is not available, consideration will be given to the use of apparatus complying as a minimum, with the following requirements provided no explosive gases will be present:

(a) the enclosure is to be at least dust protected (IP5X) having, when type tested, an ingress of fine dust within the enclosure not exceeding 10 g per m^3 of free air space, and
(b) the surface temperature of the apparatus, under the most onerous combination of normal operating conditions, but in the absence of a dust layer, is ~~to be at least 10°C below the auto-ignition temperature of the dusts encountered~~ not to exceed two-thirds of the minimum ignition temperature in degrees Celsius of the dust/air mixture(s) that can be present, or
(c) the equipment is to be certified intrinsically-safe having a temperature classification ensuring compliance with (b), or
(d) pressurised and operated in accordance with procedures ensuring, prior to its re-energisation, the absence of dust within the enclosure following loss of pressurisation and consequent shutdown, and having surface temperature complying with (b), or
(e) simple apparatus included in intrinsically-safe circuits or radio aerials, complying with ~~13.2.2(b) or (c)~~, 13.2.5 or 13.2.6 respectively.

13.3.5 Consideration may also be given to arrangements complying with IEC 60092-506, *Electrical Installation in Ships – Special Features – Ships carrying specific dangerous goods and materials hazardous only in bulk*.

~~13.3~~ 13.4 Installation of electrical equipment

~~*13.3.1*~~ *13.4.1* The method of installation and application of ~~safe-type~~ electrical equipment suitable for use in explosive gas atmospheres or in the presence of combustible dusts is to be in accordance with IEC 60079-14, or the national code of practice relevant to the standard ~~to which the equipment has been certified.~~ with which the equipment complies. Any special requirements laid down by the equipment certification documentation are also to be observed. The ambient temperature range for which the apparatus is certified is to be taken to be –20°C to 40°C, unless otherwise stated, and account is to be taken of this when assessing the suitability of the equipment for the auto-ignition temperature of the gases and dusts encountered. Any special requirements laid down by the equipment certification documentation are also to be observed. The ambient temperature range for which the apparatus is certified, is to be taken to be minus 20°C to 40°C, unless otherwise stated, and account is to be taken of this when assessing the suitability of the equipment for the auto-ignition temperature of the gases and dusts encountered.

~~*13.3.2*~~ *13.4.2* All switches and protective devices from which equipment located in ~~dangerous~~ hazardous zones or spaces is supplied are to interrupt all poles or phases and, where practicable are to be located in a non-hazardous zone or space. Such equipment, switches and protective devices are to be suitably labelled for identification purposes.

~~13.4 Dangerous zones and spaces~~

Existing sub-Section 13.4 *has been deleted.*

13.5 Hazardous zones and spaces

13.5.1 Hazardous zones or spaces and sources of hazard for ships intended for the carriage in bulk of oil, liquefied gases and other hazardous substances, and the requirements for ships carrying vehicles with fuel in their tanks, are defined (either directly, or by reference to other documents) in 13.10 to 13.14.

13.5.2 Hazardous areas associated with flammable liquids or gases are classified into zones based upon the frequency of the occurrence and duration of an explosive gas atmosphere, as follows:

- **zone 0**: place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is present continuously or for long periods or frequently
- **zone 1**: place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is likely to occur in normal operation occasionally
- **zone 2**: place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

See IEC 60079-10, *Electrical apparatus for explosive gas atmospheres: Classification of hazardous areas*.

13.5.3 Hazardous areas associated with solid substances or packaged liquids to which 13.14 applies are classified into zones based upon the frequency of the occurrence and duration of an explosive atmosphere due to the presence of gas and/or dust, as follows:

- **hazardous area**: area in which an explosive atmosphere is likely to occur in normal operation (comparable with **zone 1**)
- **extended hazardous area**: area in which an explosive atmosphere is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only (comparable with **zone 2**).

See IEC 60079-10-2, *Explosive atmospheres: Classification of areas – Combustible dust atmospheres*, or IEC 60092-506, *Electrical Installation in Ships – Special Features – Ships carrying specific dangerous goods and materials hazardous only in bulk*. An explosive atmosphere may exist due to gas and/or dust.

13.5.4 The following principles are to apply in general, and where any specific arrangement does not fall into any of the categories covered by 13.10 to 13.14.

13.5.5 A hazardous zone or space may arise from the presence of any of the following:

(a) spaces or tanks containing either:
  (i) flammable liquid having a flashpoint (closed-cup test) not exceeding 60°C;
  (ii) flammable liquid having a flashpoint exceeding 60°C, heated or raised by ambient conditions to a temperature within 15°C of its flashpoint; or
  (iii) flammable gas;
(b) piping systems or equipment containing fluid defined by (a) and having flanged joints or glands or other openings through which leakage of fluid may occur under normal operating conditions;
(c) spaces containing solids, such as coal or grain, liable to release flammable gas and/or combustible dust;
(d) spaces containing dangerous goods in packaged form, of the following Classes as defined in the IMDG Code: 1 (with the exception of goods in division 1.4, compatibility group S), 2.1 (inclusive of applicable gas bottles for on board use), 3, 6.1 and 8;
(e) piping systems or equipment associated with processes (such as electrochlorination) generating flammable gas as a by-product and having openings from which the gas may escape under normal operating conditions; or
(f) piping systems or equivalent containing flammable liquids not defined by (a), having flanged joints, glands or other openings through which leakage of fluid in the form of a mist or fine spray may occur under normal operating conditions.

13.5.6 The following zones or spaces are regarded as hazardous, **zone 0**:

(a) the interiors of those spaces, tanks, piping systems and equipment defined by 13.5.5(a) and (b); and
(b) enclosed, unventilated spaces containing pipework or equipment defined by 13.5.5(b) and (e).

13.5.7 The following zones or spaces are regarded as hazardous, **zone 1**:

(a) the interiors of spaces containing dangerous goods as defined by 13.5.5(d);
(b) unventilated spaces separated by a single bulkhead or deck from a cargo defined by 13.5.5(a);
(c) ventilated spaces containing pipework or equipment defined by 13.5.5(b) and (e);
(d) zones within a 1,5 m radius of ventilation outlets, hatches or doorways or other openings into spaces defined by (a), (b) or (c), or within 1,5 m of the ventilation outlets of spaces regarded by 13.7 as open areas and which contain the pipework or equipment defined by 13.5.5(b) or (e). Where the hazard results from flammable gas or vapour having a density relative to that of air of more than 0,75, the hazardous zone is considered to extend vertically downward to solid deck, or for a distance of 9 m, whichever is the lesser;
(e) zones within a 1,5 m radius of flanged joints, or glands or other openings defined by 13.5.5(b); in the case of gas or vapour having a relative density of more than 0,75, the hazardous zone is considered to extend vertically downwards as described under (d);
(f) zones within a 1,5 m radius of flanged joints, or glands or other openings defined by 13.5.5(e) and (f);
(g) zones within a 1,5 m radius of bunds or barriers intended to contain spillage of liquids defined by 13.5.5(a);
(h) zones on open deck within a 1,5 m radius of any opening into a space defined by (a) or (b; and
(j) enclosed or semi-enclosed spaces with direct opening into a **zone 1** hazardous location.

13.5.8 The following zones or spaces are regarded as hazardous, **zone 2**:

(a) ventilated spaces separated by a single bulkhead or deck from a **zone 0** space;
(b) zones on open deck extending 1,5 m beyond those defined by 13.5.7(d), (e), (f), (g) or (h);
(c) zones within a 1,5 m radius of ventilation inlets serving spaces defined by 13.5.7(a) or (c); and
(d) enclosed or semi-enclosed spaces with direct opening into a **zone 2** hazardous location.

~~13.5~~ 13.6 Semi-enclosed spaces

Existing paragraph 13.5.1 *has been renumbered* 13.6.1.

~~13.6~~ 13.7 Ventilation

~~*13.6.1*~~ *13.7.1* Where an enclosed or semi-enclosed space is provided with mechanical ventilation ensuring at least 12 air changes/hour, and leaving no areas of stagnant air, it may be regarded in consideration of ~~dangerous~~ hazardous zones as would otherwise be defined by ~~13.4.3(c) and (d)~~ 13.5.6(b), 13.5.7(c) or (j) and 13.5.8(d), as an open area.

~~*13.6.2*~~ *13.7.2* Where the rate of ventilation air flow, in relation to the maximum rate of release of flammable substances reasonably to be expected under normal conditions, is sufficient to prevent the concentration of flammable substances approaching their lower explosive limit, consideration may be given to regarding as ~~non-dangerous~~ non-hazardous, the space, ventilation and other openings into it, and the zone around the equipment contained within.

Existing paragraph 13.6.3 *has been renumbered* 13.7.3.

~~13.7~~ 13.8 Pressurisation

~~*13.7.1 A space having access to a dangerous space or zone as defined under 13.4.3(c) to (j) may be regarded as non-dangerous if fulfilling all the following conditions:*~~

~~(a) access is by means of an air-lock, having gastight steel doors, the inner of which as a minimum, is self-closing without any hold-back arrangement;~~
~~(b) it is maintained at an overpressure relative to the external hazardous area by ventilation from a non-dangerous area;~~
~~(c) the relative air pressure within the space is continuously monitored and, so arranged, that in the event of loss of overpressure an alarm is given and the electrical supply to all equipment not of a safe type is automatically disconnected. Where the shutdown of equipment could introduce a hazard, an alarm may be given, in lieu of shutdown, upon loss of overpressure, and a means of disconnection of non-safe type electrical equipment, capable of being controlled from a manned station, provided in conjunction with an agreed operational~~

~~procedure; where the means of disconnection is located within the space then it is to be effected by equipment of a safe type;~~

~~(d) any electrical equipment required to operate upon loss of overpressure, lighting fittings (see 5.7.3) and equipment within the air lock, is to be of a safe type;~~

~~(e) means are to be provided to prevent electrical equipment, other than of a safe type, being energised until the atmosphere within the space is made safe, by air renewal of at least 10 times the capacity of the space.~~

13.8.1 A space having access to a hazardous space or zone defined as **zone 1** or **zone 2** may be regarded as non-hazardous if fulfilling all the following conditions:

(a) access is by means of an air-lock, having gastight steel doors, the inner of which as a minimum, is self-closing without any hold-back arrangement;

(b) it is maintained at an overpressure relative to the external hazardous area by ventilation from a non-hazardous area;

(c) the relative air pressure within the space is continuously monitored and so arranged that, in the event of loss of overpressure, an alarm is given and the electrical supply to all equipment not of a type suitable for **zone 1** is automatically disconnected. Where the shutdown of equipment could introduce a hazard, an alarm may be given, in lieu of shutdown, upon loss of overpressure, and a means of disconnection of electrical equipment not of a type suitable for **zone 1**, capable of being controlled from an attended station, provided in conjunction with an agreed operational procedure; where the means of disconnection is located within the space then it is to be effected by equipment of a type suitable for **zone 1**;

(d) any electrical equipment required to operate upon loss of overpressure, lighting fittings (*see* 5.7.3) and equipment within the air-lock, is to be of a type suitable for **zone 1**; and

(e) means are to be provided to prevent electrical equipment, other than of a type suitable for **zone 1**, being energised until the atmosphere within the space is made safe, by air renewal of at least 10 times the capacity of the space.

13.8.2 A space having access to a hazardous space or zone defined as **zone 2** may be regarded as non-hazardous if fulfilling all the following conditions:

(a) access is by means of a self-closing gastight steel door without any hold-back arrangement;

(b) it is maintained at an overpressure relative to the external hazardous area by ventilation from a non-hazardous area;

(c) the relative air pressure within the space is continuously monitored and so arranged that, in the event of loss of overpressure, an alarm is given. A means of disconnection of electrical equipment not of a type suitable for **zone 2** is to be provided; where the means of disconnection is located within the space then it is to be effected by equipment of a type suitable for **zone 2**;

(d) any electrical equipment required to operate upon loss of overpressure (e.g. lighting fittings, *see* 5.7.3), is to be of a type suitable for **zone 2**.

~~13.8~~ 13.9 Cable and cable installation

~~13.8.1~~ 13.9.1 Electric cables are not to be installed in ~~dangerous~~ hazardous zones or spaces, except ~~where specifically permitted by 13.9 to 13.11 or~~ when ~~associated with~~ forming part of an intrinsically-safe ~~circuits~~ circuit or where specifically permitted elsewhere in this Section.

13.9.2 Electric cables are not, as far as is practicable, to be installed in hazardous zones or spaces, except where serving equipment installed within the zone or space. Through runs of cable may be accepted in locations classified as **zone 1** or **zone 2**, where alternative routes are impracticable.

~~13.8.2~~ 13.9.3 In addition to the requirements of Section 10, cables for circuits that are not intrinsically-safe, which are located in ~~dangerous~~ hazardous zones or spaces, or which may be exposed to cargo oil, oil vapour or gas, are to be either:

(a) mineral insulated with copper sheath, or

(b) armoured or braided for earth detection.

(c) otherwise adequately protected against mechanical or chemical damage, within **zone 2** or non-hazardous locations only, or

(d) as otherwise specifically permitted elsewhere within this Section.

Existing paragraphs 13.8.3 *and* 13.8.4 *have been renumbered* 13.9.4 *and* 13.9.5.

~~13.8.5~~ 13.9.6 Cables associated with intrinsically-safe circuits are to be used only for such circuits. They are to be physically separated from cables associated with non-intrinsically-safe circuits, e.g. neither installed in the same protective casing nor secured by the same fixing clip. Consideration may be given to other arrangements complying with IEC 60079-14, *Explosive atmospheres: Electrical installations design, selection and erection*.

13.9.7 In **zone 0**, cable joints may only be used in intrinsically-safe circuits.

13.9.8 Cable runs in **zone 1** or **zone 2** are, where practicable, to be uninterrupted. Where discontinuities cannot be avoided, cable joints are, additionally, to:

- be made in an enclosure with a type of protection appropriate to the location; or
- provided the joint is not subject to mechanical stress, be epoxy filled, compound-filled or sleeved with heat-shrunk tubing, in accordance with the manufacturer's instructions.

~~13.9~~ 13.10 Requirements for tankers intended for the carriage in bulk of oil cargoes having a flash point not exceeding 60°C (closed-cup test)

Existing paragraph 13.9.1 *has been renumbered* 13.10.1.

13.10.2 The relevant group and temperature class for electrical equipment in hazardous zones are, respectively, IIA and T3.

~~13.10~~ 13.11 Requirements for ships for the carriage of liquefied gases in bulk

Existing paragraph 13.10.1 *has been renumbered* 13.11.1.

~~13.11~~ 13.12 Requirements for ships intended for the carriage in bulk of other flammable liquid cargoes

Existing paragraph 13.11.1 *has been renumbered* 13.12.1.

~~13.12~~ 13.13 Special requirements for ships with spaces for carrying vehicles with fuel in their tanks, for their own propulsion

~~13.12.1~~ 13.13.1 **Passenger ships with special category spaces above the bulkhead deck for carrying vehicles**:

(a) electrical equipment fitted within a height of 45 cm above the vehicle deck, or any platform on which vehicles are carried, or within the exhaust ventilation trunking for the space, is to be of a ~~safe-type~~ type acceptable for **zone 1**;

(b) electrical equipment situated elsewhere within the space is to be of a type acceptable for **zone 2**, or is to have an enclosure of ingress protection rating of at least IP55~~, if not of a safe-type~~, *see* IEC 60529: *Classification of Degrees of Protection Provided by Enclosures*. Smoke and gas detector heads are exempt from this requirement.

~~13.12.2~~ 13.13.2 **Passenger ships with special category spaces below the bulkhead deck for carrying vehicles**: electrical equipment fitted within the space and within the exhaust ventilation trunking for the space, is to be of a ~~safe-type~~ type acceptable for **zone 1**.

~~13.12.3~~ 13.13.3 **Passenger ships** ~~with cargo spaces, other than special category spaces, for carrying vehicles~~ **with cargo spaces, other than special category spaces, for carrying vehicles**:

(a) electrical equipment within such a cargo space, or within the exhaust ventilation trunking for the space, is to be of a ~~safe-type~~ type acceptable for **zone 1**;

(b) all electrical circuits terminating in the cargo space are to be provided with multipole linked isolating switches located outside the cargo hold. Provision is to be made for locking in the off position. This does not apply to safety circuits such as those for fire, smoke or gas detection.

~~13.12.4~~ 13.13.4 **Cargo ships with closed ro-ro cargo spaces for carrying vehicles**:

(a) except where exempted by (b) electrical equipment fitted within the space and within the exhaust ventilation trunking for the space is to be of a ~~safe-type~~ type acceptable for **zone 1**;

(b) where the ventilation system required by SOLAS 1974 as amended, Chapter II-2, Regulation 20.3.1.1.1 is arranged to operate continuously and is sufficient to provide at least ten air changes per hour, whenever vehicles are on board, above a height of 45 cm from the vehicle deck, or any platform on which vehicles are carried, electrical equipment ~~having an enclosure of ingress protection rating of at least IP 55 may be accepted as an alternative to that of a safe-type~~ is to be of a type acceptable for **zone 2**, or is to have an enclosure of ingress protection rating of at least IP 55;

(c) all electrical circuits terminating in the cargo space are to be provided with multipole linked isolating switches located outside the cargo hold. Provision is to be made for locking in the off position. This does not apply to safety circuits such as those for fire, smoke or gas detection.

~~13.13~~ 13.14 Special requirements for ships intended for the carriage of dangerous goods and materials hazardous only in bulk

~~13.13.1~~ 13.14.1 In order to eliminate potential sources of ignition in enclosed cargo spaces or vehicle spaces in accordance with SOLAS 1974 as amended, Chapter II-2, Regulation 19.3.2, and from associated hazardous areas (*see* ~~13.4.2~~ 13.5.3), electrical equipment is to be selected in accordance with ~~13.13.2 and 13.13.3~~ 13.14.2 and 13.14.3 and installed in accordance with ~~13.3 and 13.13.4 to 13.13.7~~ 13.4 and 13.14.4 to 13.14.7.

~~13.13.2~~ 13.14.2 Electrical equipment essential for the safety and operation of the ship is to be of a ~~certified safe type~~ type providing protection against ignition of the gases and/or dusts that can be present, selected in accordance with IEC 60092-506 *Electrical installations in ships~~—Part 506~~: Special features – Ships carrying specific dangerous goods and materials hazardous only in bulk*.

Existing paragraph 13.13.3 *has been renumbered* 13.14.3.

~~13.13.4~~ 13.14.4 Electrical equipment not essential for the safety or operation of the ship and which is not of a ~~certified safe~~ type providing protection against ignition of the gases and/or dusts that can be present is to be completely disconnected and protected against unauthorised re-connection. Disconnection is to be made outside the hazardous areas and be effected with isolating links or lockable switches.

Existing paragraph 13.13.5 *has been renumbered* 13.14.5.

~~13.13.6~~ 13.14.6 Cables joints in cargo spaces are to be avoided where possible. Where joints are unavoidable, they are to be enclosed in metal-clad or high impact strength plastic junction boxes of ~~certified safe type (see 13.13.2)~~ a type acceptable for **zone 1** or a hazardous area as defined in 13.5.3 or heat-shrink or encapsulated crimp sleeve cable joints.

Existing paragraph 13.13.7 *has been renumbered* 13.14.7.

■ *Section 14*
Navigation and manoeuvring systems

14.5 Navigation lights

14.5.1 Navigation lights are to be connected separately to a distribution board reserved for this purpose only and accessible to the officer of the watch. This distribution board is to be connected directly or through transformers to the emergency source of electrical power in compliance with, for passenger ships, 3.2.7(b) and 3.2.9(a)(i) or, for cargo ships, 3.3.7(c) and 3.3.9(a). An alarm is to be activated in the event of failure of a power supply from the distribution board.

14.5.3 Provision is to be made on the navigating bridge for the navigation lights to be transferred to an alternative circuit fed from the main source of electrical power.

Existing paragraphs 14.5.3 *to* 14.5.5 *have been renumbered* 14.5.4 *to* 14.5.6.

~~*14.5.6* Provision is to be made on the navigating bridge for the navigation lights to be transferred to an alternative circuit fed from the main source of electrical power.~~

14.5.7 Navigation light power supply units installed to convert, control and/or monitor the distribution board power supply required by 14.5.1 above for connection to the light source(s) (e.g. for LED type navigation lights) are, in the event of a short-circuit on the unit output, to disconnect or limit the supply to prevent further damage and activate an alarm.

14.5.8 Navigation light power supply units are to be self-checking, detecting failures of the unit itself and activating an alarm. These are to include:

- detection of system lock-ups (program hangs);
- means to detect failure of navigation light switching command input circuits or links; and
- means to detect failure of the navigation light monitoring arrangements required to provide the alarms required by 14.5.4 and 14.5.5, as applicable.

14.5.9 The navigation light power supply failure alarms required by 14.5.1 are not to be displayed as a group alarm. Other navigation light alarms may be grouped for each navigation light where means are provided for personnel to determine the cause of the alarm. Activation of more than one of the navigation light alarms as a result of a single failure is to be prevented.

Existing paragraph 14.5.7 *has been renumbered* 14.5.10.

■ *Section 16*
Fire safety systems

16.1 Fire detection and alarm systems

16.1.3 Fire detection systems within the accommodation spaces and cabin balconies are, in addition to the requirements of Ch 1,2.8.4, 2.8.6, 2.8.8 and 2.8.10 to 2.8.14, to comply with 16.1.4 to ~~16.1.15~~ 16.1.16.

16.1.8 Where the fire detection system does not include means of remotely identifying each detector and manually operated call point individually no section covering more than one deck within accommodation, service spaces and control stations is normally to be permitted except a section which covers an enclosed stairway. The number of enclosed spaces in each section are to be limited to the minimum considered necessary in order to avoid delay in identifying the source of fire. In no case are more than fifty spaces permitted in any section.

16.1.10 A section of fire detectors and manually operated call points which covers a control station, a service space or an accommodation space is not to include a machinery space of Category A.

16.1.12 A loop circuit of an addressable fire detection system, capable of remotely identifying from either end of the loop each detector and manually operated call point served by the circuit, may serve spaces on both sides of the ship and on several decks, but is not to be situated in more than one main vertical or horizontal fire zone, nor is a loop circuit which covers ~~a control station or an accommodation space~~ an accommodation space, service space and/or control station to include a machinery space of Category A.

16.1.13 A loop circuit of an addressable fire detection system may comprise one or more sections ~~of detectors~~. Where the loop comprises more than one section, the sections are to be separated by devices which will ensure that if a short-circuit occurs anywhere in the loop, only the affected section ~~of detectors~~ will be isolated from the control panel. No section ~~of detectors~~ is in general to include more than 50 detectors.

~~*16.1.14* A section of detectors of an addressable fire detection system is neither to serve spaces on both sides of the ship nor on more than one deck, except that:~~

~~(a) a section of detectors may serve spaces on more than one deck if those spaces are located in either the fore or aft end of the ship, or they constitute common spaces occupying several decks (i.e. public spaces, enclosed stairways, etc.); or~~

~~(b) in ships of less than 20 m in breadth, a section of detectors may serve spaces on both sides of the ship.~~

16.1.14 A section of fire detectors and manually operated call points is not to be situated in more than one main vertical zone.

16.1.15 The wiring for each section of detectors and manually operated call points in an addressable fire detector system is to be separated as widely as practicable from that of all other sections on the same loop. Where practicable no loop is to pass through a space twice. When this is not practical, such as in large public spaces, the part of the loop which by necessity passes through the space for a second time is to be installed at the maximum possible distance from other parts of the loop.

16.3 Fixed water-based local application fire-fighting systems

16.3.10 The evidence required by 16.3.9 is to demonstrate the safe and effective operation of the overall arrangements in the event of system operation. This evidence is to demonstrate that exposure to system spray and/or water:

- cannot result in loss of essential services (~~i.e.~~ e.g. unintended activation of automatic machinery shut-down ~~due to sensor failure~~);
- cannot result in loss of availability of emergency services;
- will not affect the continued safe and effective operation of electrical and electronic equipment required to operate during the required period of system operation;
- does not present additional electrical or fire hazards; and
- would require only identified readily replaceable components to be repaired or replaced.

The installation of electrical and electronic equipment required to provide essential or emergency services in enclosures with a degree of protection less than IP44 within areas exposed to direct spray is to be acceptable to LR, and evidence of suitability is to be submitted accordingly.

16.6 Fire safety stops

16.6.6 In passenger ships carrying ~~more than~~ 36 passengers or more, exhaust ducts from main laundries are to be fitted with additional remote-control arrangements for shutting off the exhaust fans and supply fans from within the space and for operating electrically operated fire dampers fitted at the lower end of the duct.

16.8 Fire dampers

16.8.3 In passenger ships carrying ~~more than~~ 36 passengers or more, where electrically operated fire dampers are fitted at the lower end of exhaust ducts from main laundries, they are to be capable of automatic and remote operation.

16.11 Electrically powered air compressors for breathing air cylinders

16.11.1 In passenger ships carrying more than 36 passengers where electrically powered air compressors are installed as part of the means required by SOLAS 1974 as amended, Chapter II-2/C, for recharging breathing apparatus air cylinders for fire-fighter's outfits, the compressors are to be supplied by the main and emergency sources of electrical power. Details of the emergency supply electrical load, supply changeover arrangements and operation under fire conditions are to be submitted for consideration. The arrangements are to be to the satisfaction of the National Administration with which the ship is registered.

■ *Section 17*
Crew and passenger emergency safety systems

17.2 General emergency alarm system

17.2.4 There are to be segregated cable routes to public rooms, alleyways, stairways, ~~and~~ control stations and on passenger ships on open decks, so arranged that any single electrical fault, localised fire or casualty will not cause the loss of the facility to sound the general emergency alarm in any public rooms, alleyways, stairways, ~~and~~ control stations and on passenger ships on open decks, ~~be it~~ albeit at a reduced capacity.

Part 7, Chapter 5
Ships Equipped for Oil Recovery Operations

Effective date 1 July 2010

■ *Section 5*
Electrical equipment

5.5 Pressurisation

5.5.1 A space having access to a hazardous space or zone, as defined under 5.3.1(c) to (j), may be regarded as non-hazardous if it fulfils all of the following conditions:

(a) Access is by means of an air-lock, having gastight doors, the inner of which, as a minimum, is self-closing without any hold-back arrangement.

(b) It is maintained at an over-pressure of at least 50 Pa relative to the external hazardous area by ventilation from a ~~non-dangerous~~ non-hazardous area.

(c) The relative air pressure within the space is continuously monitored and so arranged that, in the event of loss of over-pressure, an alarm is given at an attended station.

(d) It contains no piping system or equipment of a type described in 5.3.1(d), and no vent from or opening into any hazardous space or zone defined by 5.3.1, other than the access under consideration.

(e) It is separated by at least two gastight bulkheads from the interior of any tank intended for recovered oil.

Part 7, Chapter 6
Arrangements for Offshore Loading

Effective date 1 July 2010

■ *Section 5* Piping systems

5.2 Piping system design

5.2.9 Zones on open deck within 3 m of loading manifolds or pipe joints, and within 3 m of the spillage drip tray, are to be regarded as ~~dangerous~~ hazardous with regard to machinery or other equipment which could constitute a possible source of ignition, *see also* Pt 6, ~~Ch 2,13.4 and 13.9~~ Ch 2,13.5 and 13.10.

Part 7, Chapter 9
Navigational Arrangements and Integrated Bridge Systems

Effective date 1 July 2010

■ *Section 2* Physical conditions

2.4 Windows

2.4.1 All wheelhouse windows are to be constructed of shatterproof toughened glass having a strength commensurate with the degree of exposure of the bridge to storm conditions and complying with a recognised National or International Standard, e.g. ~~ISO 3254 *Shipbuilding and marine structures – Toughened safety glass for rectangular windows*~~ ISO 21005, *Ships and marine technology – Thermally toughened safety-glass panes for windows and side scuttles*.

■ *Section 3* Workstations

3.1 Navigation workstation

3.1.5 Two functionally independent radars or alternative means are to be provided to determine and display the range and bearing of radar transponders and other surface craft, obstructions, buoys, shorelines and navigational marks. One of the radars is to operate in the X-band (9 GHz) and the other is to operate in the S-band (3 GHz). ~~Both radars are to include automatic plotting aids to determine collision risks, and at least one radar is to be equipped with an automatic radar plotting aid (ARPA), capable of tracking at least 20 targets, while the other is to be either ARPA or an automatic tracking aid (ATA).~~

■ *Section 4* Systems

4.1 Alarm and warning systems

4.1.2 The following alarms are to be provided:

- Closest point of approach.
- Shallow depth.
- Waypoint approaching (where automatic track following is provided).
- Off-course.
- Off-track (where automatic track following is provided).
- Steering alarms, *see* Table 19.5.1 in Pt 5, Ch 19 or Table 20.4.1 in Pt 5, Ch 20, as applicable.
- Navigation light failure alarms, *see* Pt 6, Ch 2,14.5, including 14.5.8 for grouping.
- Gyrocompass failure.
- Watch safety system failure.
- Failure of any power supply to the distribution panels referred to in 4.4.1.

4.2 Watch safety system

4.2.1 A watch safety system satisfying the requirements of the IMO ~~performance standards for a bridge navigational watch alarm system (BNWAS)~~ IMO Resolution MSC.128(75), *Performance standards for a bridge navigational watch alarm system* (BNWAS), and approved by the national administration is to be provided to monitor the well-being and awareness of the watchkeeper. ~~The system is not to cause undue interference with the performance of bridge functions.~~

~~*4.2.2* The watch safety system is to automatically become operational whenever the ships heading or track control system is activated.~~

~~*4.2.3* The system is to be such that, at a predetermined time, the watchkeeper receives warning that he must indicate his well-being by accepting the warning.~~

~~*4.2.4* The time interval between warnings is to be adjustable up to a maximum of 12 minutes.~~

~~*4.2.5* It is to be possible to acknowledge the warning at the navigation workstation and at other appropriate locations on the bridge where an effective look-out may be kept. Acknowledgement of any alarm is automatically to reset the time interval between warnings. Manual adjustment of controls may also be used for this purpose.~~

~~*4.2.6* Visual warning indications are to be visible, and audible warning indications are to be audible, from all operational positions on the bridge where the watchkeeper may reasonably be expected to be stationed. The colour of visual indicators is not to impair night vision.~~

~~*4.2.7* In the event that the watchkeeper fails to respond and accept the warning or if any alarm has not been acknowledged on the bridge, within a period of 30 seconds, the system is to immediately initiate a watch alarm to warn the Master and the appointed backup navigator through a fixed installation.~~

~~*4.2.8* In the event that the watch alarm is not acknowledged, the system is to initiate the watch alarm at the locations of further crew members capable of taking corrective actions following a time delay sufficient to allow the Master or backup navigator to reach the bridge. The time interval is to be adjustable between 90 seconds up to a maximum of 3 minutes. In ships, other than passenger ships, the watch alarm to warn the further crew members may be initiated at the same time as the watch alarm to warn the Master and backup navigator.~~

~~*4.2.9* The watch alarms which sound in the locations of the Master, officers and further crew members capable of taking corrective action should be easily identifiable by its sound and should indicate urgency. The volume of this alarm should be sufficient for it to be heard throughout the locations above and to wake sleeping persons.~~

~~*4.2.10* Manual initiation of the watch alarm from the bridge is to be possible at any time.~~

~~*4.2.11* The system is to be designed and arranged such that only the ship's Master has access for enabling and disabling it and setting the appropriate intervals, so as to prevent accidental or unauthorised operation, e.g. removing the fuses or keeping the acknowledgement button permanently depressed either accidentally or deliberately.~~

~~*4.2.12* The fixed installation is to be connected to the Master's and navigating officers' cabins, offices, mess and public rooms.~~

~~*4.2.13* Acknowledgement of the watch alarm is only to be possible on the bridge.~~

~~*4.2.14* *4.2.2* If, depending upon the shipboard work organisation, the backup navigator may attend locations not connected to the alarm transfer system, a wireless portable device is to be provided enabling both the transfer of alarms and two-way speech communication with the bridge. An audible warning from the portable device is to be provided in the event of loss of the wireless link with the bridge. Alternative arrangements will be considered.

~~*4.2.15* Failure of the watch alarm system is to activate an audible and visual alarm at the centralised alarm system.~~

4.2.3 Acknowledgement of any alarm is to automatically reset the time interval between warnings. Manual adjustment of controls may also be used for this purpose. Manual adjustment of controls and navigation equipment (*see also* 5.3.14) is to automatically reset the watch safety interval timer. Reset arrangements based on the detection of movement in the bridge are not considered to satisfy this requirement or to confirm well-being and watch-keeping awareness.

■ *Section 5*
Integrated Bridge Navigation System – IBS notation

5.5 Alarm management

5.5.7 The following alarms are not to be grouped:

- Emergency alarms.
- Separate group alarms associated with faults requiring speed or power reduction or the automatic shutdown of propulsion machinery.
- Steering gear alarms.
- Navigation light power supply failure alarms, *see* Pt 6, Ch 2,14.5.8.

~~Part 7, Chapter 13~~

~~Arrangements and Equipment for the Safety of Bulk Carriers and Single Hold Cargo Ships other than Bulk Carriers~~

Effective date 1 July 2010

Part 7, Chapter 13 has been deleted.

~~*Section 1* Water ingress detection arrangements~~

~~1.1 General requirements~~

~~*1.1.1* Equipment for detecting the ingress of water in bulk carriers is to be fitted in accordance with the requirements of SOLAS 1974 as amended, Chapter XII, Regulation 12.~~

~~*1.1.2* Equipment for detecting the ingress of water in single hold cargo ships is to be fitted in accordance with the requirements of SOLAS 1974 as amended, Chapter II-1, Regulation 25.~~

~~*1.1.3* The audible and visual alarms specified in 1.2 and 1.3 are to be located on the navigation bridge.~~

~~1.2 Water ingress detection arrangements in bulk carriers~~

~~*1.2.1* Bulk carriers are to be fitted with water level detectors:~~

~~(a) In each cargo hold, giving audible and visual alarms, one when the water level above the inner bottom in any hold reaches a height of 0,5 m and another at a height not less than 15 per cent of the depth of the cargo hold but not more than 2 m. The water level detectors are to be fitted in the aft end of the cargo holds. For cargo holds which are used for water ballast, an alarm overriding device may be installed. The visual alarms are to clearly discriminate between the two different water levels detected in each hold;~~

~~(b) in any ballast tank forward of the collision bulkhead required by Pt 3, Ch 3,4, giving an audible and visual alarm when the liquid in the tank reaches a level not exceeding 10 per cent of the tank capacity. An alarm overriding device may be installed to be activated when the tank is in use; and~~

~~(c) in any dry or void space other than a chain cable locker, any part of which extends forward of the foremost cargo hold, giving an audible and visual alarm at a water level of 0,1 m above the deck. Such alarms need not be provided in enclosed spaces the volume of which does not exceed 0,1 per cent of the ship's maximum displacement volume.~~

~~1.3 Water ingress detection arrangements in single hold cargo ships~~

~~*1.3.1* Ships having a length (*L*) of less than 80 m and a single cargo hold below the freeboard deck or cargo holds below the freeboard deck which are not separated by at least one bulkhead made watertight up to that deck, are to be fitted in such space or spaces with water level detectors.~~

~~*1.3.2* The water level detectors required by 1.3.1 are to:~~

~~(a) give an audible and visual alarm when the water level above the inner bottom in the cargo hold reaches a height of not less than 0,3 m, and another when such level reaches not more than 15 per cent of the mean depth of the cargo hold; and~~

~~(b) be fitted at the aft end of the hold, or above its lowest part where the inner bottom is not parallel to the designed waterline. Where webs or partial watertight bulkheads are fitted above the inner bottom, the installation of additional detectors is to be considered.~~

~~*1.3.3* The water level detectors required by 1.3.1 need not be fitted in ships complying with 1.2, or in ships having watertight side compartments each side of the cargo hold length which extend vertically at least from inner bottom to freeboard deck.~~

~~*Section 2* Drainage and pumping arrangements~~

~~2.1 General requirements~~

~~*2.1.1* Arrangements for drainage and pumping are to be in accordance with the requirements of SOLAS 1974 as amended, Chapter XII, Regulation 13.~~

~~*2.1.2* On bulk carriers, the means for draining and pumping ballast tanks forward of the collision bulkhead and bilges of dry spaces any part of which extends forward of the foremost cargo hold are to be capable of being brought into operation from a readily accessible enclosed space, the location of which is accessible from the navigation bridge or propulsion machinery control position without traversing exposed freeboard or superstructure decks. Where pipes serving such tanks or bilges pierce the collision bulkhead, valve operation by means of remotely operated actuators may be accepted, as an alternative to the valve control specified in Pt 5, Ch 13,3.5.4, provided that the location of such valve controls complies with this requirement.~~

~~**2.2 Dewatering capability**~~

~~*2.2.1 The dewatering system for ballast tanks located forward of the collision bulkhead, and for bilges of dry spaces any part of which extends forward of the foremost cargo hold, is to be designed to remove water from the forward spaces at a rate of not less than $320A$ m³/h, where A is the cross-sectional area in m² of the largest air pipe or ventilator pipe connected from the exposed deck to a closed forward space that is required to be dewatered by those arrangements.*~~

Part 7, Chapter ~~14~~ 13
Passenger and Crew Accommodation Comfort

Effective date 1 July 2010

Part 7, Chapter 14 has been renumbered Chapter 13.

Part 7, Chapter ~~15~~ 14
On-shore Power Supplies

Effective date 1 July 2010

Part 7, Chapter 15 has been renumbered Chapter 14.

Part 7, Chapter ~~16~~ 15
Requirements for Machinery and Engineering Systems of Unconventional Design

Effective date 1 July 2010

Part 7, Chapter 16 has been renumbered Chapter 15.

Part 7, Chapter ~~17~~ 16
Refrigeration Systems and Equipment Serving Provision Stores and Air-Conditioning Installations

Effective date 1 July 2010

Part 7, Chapter 17 has been renumbered Chapter 16.

Part 8, Chapter 2
Ice Operations – Ice Class

Effective date 1 July 2010

■ *Section 11*

Machinery strengthening requirements for navigation in multi-year ice conditions – Ice Classes PC1, PC2, PC3, PC4, PC5, PC6 and PC7

11.1 Application

11.1.1 The contents of this Section apply to main propulsion, steering gear, emergency and essential auxiliary systems essential for the safety of the ship and the survivability of the crew and systems and equipment required by assigned optional classification notations, e.g. navigational equipment associated with the notations **NAV1** or **IBS**.

Section numbering in brackets reflects any Section renumbering necessitated by any of the Notices that update the current version of the Rules for Ships.

Part 1, Chapter 2

3.5.25 *Reference* Ch 3,11.2.9 *has been renumbered* Ch 3,11.2.10.

Part 1, Chapter 3

2.2.26 *Reference* Pt 7, Ch 15 *has been renumbered* Pt 7, Ch 14.

14.2.12 *Reference* Pt 7, Ch 15 *has been renumbered* Pt 7, Ch 14.

Part 3, Chapter 2

3.5.3 *Reference* Pt 6, Ch 2,13.9 *has been renumbered* Pt 6, Ch 2,13.10.

Part 3, Chapter 5

3.5.5 *Reference* Ch 13,7.10 *has been renumbered* Ch 13,8.10.

Part 3, Chapter 11

6.1.13 *References* Ch 13,7.10.5 and 7.10.7 *have been renumbered* Ch 13,8.10.5 and 8.10.7.

6.6.22 *References* Ch 13,7.10.5 and 7.10.7 *have been renumbered* Ch 13,8.10.5 and 8.10.7.

Part 3, Chapter 13

1.1.2 *Reference* Section 8 *have been renumbered* Section 9 (twice).
Reference Section 9 *has been renumbered* Section 10.

7.7.6 (***8.1.6***) *Reference* 7.7.2 *has been renumbered* 8.1.2.

7.7.5 (***8.7.2***) *References* 7.7.2 *and* 7.7.4 *have been renumbered* 8.1.2 *and* 8.7.1.

7.8.2 (***8.8.2***) *References* 7.7.2 and 7.7.4 *have been renumbered* 8.1.2, 8.2.1 to 8.7.1 *respectively*.
Reference 7.7.2(c) *has been renumbered* 8.1.2(c).

7.11.2 (***8.11.2***) *Reference* Fig. 13.7.1 *has been renumbered* Fig. 13.8.1.

7.11.3 (***8.11.3***) *Reference* Fig. 13.7.2 *has been renumbered* Fig. 13.8.2.

7.11.8 (***8.11.9***) *Reference* 7.11.4 *has been renumbered* 8.11.4.
Reference Table 13.7.7 *has been renumbered* Table 13.8.4.
Reference Section 8 *has been renumbered* Section 9.

7.11.9 (***8.11.10***) *Reference* 7.11.4 *has been renumbered* 8.11.4.
Reference 7.11.5 *has been renumbered* 8.11.5.

7.12.4 (***8.12.4***) *Reference* Table 13.7.8 *has been renumbered* Table 13.8.5.

7.12.5 (***8.12.5***) *Reference* Fig. 13.7.3 *has been renumbered* Fig. 13.8.3.

7.12.6 (***8.12.6***) *Reference* Table 13.7.8 *has been renumbered* Table 13.8.5.

7.12.8 (***8.12.8***) *Reference* Table 13.7.9 *has been renumbered* Table 13.8.6.

7.12.11 (***8.12.11***) *References* 7.12.12 and 7.12.13 (twice) *have been renumbered* 8.12.12 and 8.12.13 (twice).
Reference 7.12.14 *has been renumbered* 8.12.14.

8.1.2 (***9.1.2***) *Reference* Fig. 13.8.1 *has been renumbered* Fig. 13.9.1.

8.2.2 (***9.2.2***) *Reference* Table 13.8.1 *has been renumbered* Table 13.9.1.

8.2.3 (***9.2.3***) *Reference* Table 13.8.2 *has been renumbered* Table 13.9.2.
Reference Fig. 13.8.1 *has been renumbered* Fig. 13.9.1.
Reference Table 13.8.2 *has been renumbered* Table 13.9.2.

Table 13.8.2 (**Table 13.9.2**) *Reference* 8.1.2 *has been renumbered* 9.1.2.

8.2.4 (***9.2.4***) *Reference* Table 13.8.2 *has been renumbered* Table 13.9.2 (twice).
Reference Fig. 13.8.1 *has been renumbered* Fig. 13.9.1.
Reference Fig. 13.8.2 *has been renumbered* Fig. 13.9.2.

8.2.5 (***9.2.5***) *Reference* Table 13.8.2 *has been renumbered* Table 13.9.2.

8.2.6 (***9.2.6***) *Reference* Fig. 13.8.1 *has been renumbered* Fig. 13.9.1 (twice).

9.1.3 (***10.1.3***) *Reference* 9.1.1 *has been renumbered* 10.1.1.
Reference Table 13.9.1 *has been renumbered* Table 13.10.1.

9.2.2 (***10.2.2***) *Reference* Fig. 13.9.1 *has been renumbered* Fig. 13.10.1.

9.2.3 (***10.2.3***) *Reference* Table 13.9.2 *has been renumbered* Table 13.10.2.

Part 4, Chapter 2

9.10.1 *Reference* Pt 6, Ch 2,13.12.4 *has been renumbered* Pt 6, Ch 2,13.13.4.

Part 5, Chapter 13

Ch 13,2 *Reference* Ch 12,10 *has been renumbered* Ch 12,11.

Part 5, Chapter 14

Ch 14,7 *Reference* Ch 12,10 *has been renumbered* Ch 12,11.

Cross-References

Part 6, Chapter 1

2.13.7 *References* 2.10.19 and 2.10.20 *have been renumbered* 2.10.23 and 2.10.24.

6.3.1 *References* 2.10.19 and 2.10.20 *have been renumbered* 2.10.23 and 2.10.24.

6.2.3 *Reference* 2.12.7 *has been renumbered* 2.12.8.

Part 6, Chapter 2

1.12.2 *References* 1.11.6 and 1.11.10 *have been renumbered* 1.11.7 and 1.11.11.

1.3.5 *Reference* Pt 7, Ch 15 *has been renumbered* Pt 7, Ch 14.

1.4.4 (***1.4.5***) *References* 14.5.4 and 14.5.5 *have been renumbered* 14.5.5 and 14.5.6.

1.10.7 *Reference* 10.14 *has been renumbered* 10.15.

4.1.5 *Reference* Pt 7, Ch 15 *has been renumbered* Pt 7, Ch 14.

8.5.1(d) *Reference* Pt 3, Ch 13,7.8 *has been renumbered* Pt 3, Ch 13,8.8

10.1.1 *Reference* 10.15 *has been renumbered* 10.16.
Reference 10.16 *has been renumbered* 10.17.

10.6.5 *Reference* 1.11.7 *has been renumbered* 1.11.8.

10.8.21 *Reference* 10.13 *has been renumbered* 10.14.

10.16.1 (***10.17.1***) *Reference* 10.16.2 to 10.16.6 *has been renumbered* 10.17.2 to 10.17.6.

13.13.6 (***13.14.6***) *Reference* 13.13.2 *has been renumbered* 13.14.2.

14.5.4 (***14.5.5***) *Reference* 1.4.4 *has been renumbered* 1.4.5.
Reference 14.5.3 *has been renumbered* 14.5.4.

14.5.5 (***14.5.6***) *Reference* 14.5.4 *has been renumbered* 14.5.5.

Part 6, Chapter 3

1.1.4 *Reference* Pt 7, Ch 17 *has been renumbered* Pt 7, Ch 16.

Part 7, Chapter 6

2.1.3 *Reference* Pt 3, Ch 13,8 *has been renumbered* Pt 3, Ch 13,9.

2.3.1 *Reference* Pt 3, Ch 13,8 *has been renumbered* Pt 3, Ch 13,9.

Part 7, Chapter 5

5.1.1 *References* 13.4, 13.6, 13.7 and 13.9 *have been renumbered* 13.5, 13.7, 13.8 and 3.10.

Part 7, Chapter 10

7.1.7 *Reference* Pt 5, Ch 12,10.8 *has been renumbered* Pt 5, Ch 12,11.8.

Published by Lloyd's Register
Registered office
71 Fenchurch Street, London, EC3M 4BS
United Kingdom